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DISCOVERY

A Monthly Popular Journal of Knowledge

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"ANGEL HOLDING A RELIQUARY."

(See page 38).

CONTENTS.

	Pages
Notes of the Month...	35
Mediaeval French Art	37
Exploring Unknown Lakes ...	40
National Bias in Children... ...	44
Surveying in Labrador	47
A Romance of Modern Chile ...	50
Economic Background in Manchuria	53
Correspondence	56
Future of Dairy Research	57
An old Pamphlet from France ...	62
The Shape of the Earth	64
Book Reviews	65

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Notes of the Month.

The conquest of the Himalayas is likely to be carried a stage further this year. We understand from *The Times* that Mr. Frank Smythe, who climbed Kamet some months ago, is to lead another expedition, the new objective being Nanga Parbat, the highest peak in the Western Himalayas. If the permission of the political authorities in Kashmir can be obtained, it is proposed to attack the mountain with a three months' "siege." The only previous attempt was made in 1895 when a party led by A. F. Mummery climbed to 20,000 feet, about 7,000 feet short of the summit. Later he was killed in trying to cross Diamir Pass, but it is thought that if this pass can be reached safely the higher ascent should be possible. The experience gained last year will be a great help to Mr. Smythe, who also took part in the Kanchenjunga expedition in 1930. He is already famous as an explorer of courage and cool judgment, and everyone will wish him success in this latest endeavour to add to the laurels of British mountaineering.

* * * * *

In *Discovery* last April, Professor T. L. Shear outlined the plans for the excavation of the Agora at Athens, of which he is in charge. The work of the first season has been unusually difficult because it has been guided entirely by the second century records of Pausanias and other early visitors to Greece. Fortunately, the records have proved to be correct. One of the most interesting discoveries is the foundation of the royal stoa, and a broad thoroughfare running from north to south of the Agora has also been unearthed. This is clearly the street by which Pausanias entered the city, and its discovery is of great importance at the outset of the work, since it will doubtless lead to the other buildings mentioned in his writings. Professor Shear states that, like the other streets of ancient Athens, this is unpaved and was probably not intended for wheeled traffic. A large rectangular water channel passes through the centre of the street. The roof is constructed of heavy blocks of stone and the walls are built of masonry which dates from the early part of the fifth century B.C. Many beautiful examples of pottery and sculpture have been found, including a marble statue of the Emperor Hadrian. The discovery of many public records inscribed on slabs of stone throws new light on historical events from the sixth century B.C. to the second century A.D. The work of the past season will be described in detail by Professor Shear in our next issue. Excavations were recommenced in January, the chief objectives of the new season being the Senate House and the Temple of the Mother of the Gods, where the state archives were at one time housed.

* * * * *

Notable developments in television are forshadowed by the discussions now taking place between Baird Television, Ltd., and the B.B.C. The plans have not yet been revealed, but it is likely that the B.B.C. will in future take a more active part in transmissions and that a wider choice of subjects will be available. Meanwhile new plans for 1932 are announced by Mr. J. L. Baird, who anticipates that large television screens will be displayed this year in places of entertainment. In an interview he described the improved apparatus recently developed, which includes a television telephone, enabling subscribers to see as well as hear each other. It is already in use in France, although not yet adopted on an extensive scale. According to *The Times*, two-way television between telephone booths in New York has been successfully carried out, the images being very clear. But high-grade television is limited in its application, is expensive to maintain

and could not possibly be accommodated on the present broadcast wave-lengths. Ultra-short wave-lengths, however, are admirably suited for local television broadcasts, and it is now generally agreed that the television of the future will be accomplished by the means of these waves transmitted from a tower or hill.

* * * * *

The Department of Scientific and Industrial Research has passed another busy year. Its work ranges from the testing and distribution of radium to the study of the intestinal contents of haddocks! And the latest report reveals the fact that striped shirts wear out more quickly than plain! Unfortunately, nothing is said about the longevity of spotted shirts, but no doubt this knotty problem is engaging the attention of the experts. The advisory council once again urges industry to look on scientific research not as a last resource but as an essential part of production. Science has given valuable aid in the past and will do so in the future. It is clear from the report that manufacturers are not taking full advantage of the facilities offered by the department. On the other hand, we question whether much of this research at the taxpayer's expense is justified, at a time when economy is so essential in public affairs.

* * * * *

Stainless steel has proved so successful for aeroplane fittings that a machine made entirely of this material is to be constructed by a British manufacturer. This is mainly a measure of economy, since the cost of overhauling is considerably less than in the case of ordinary steel. In the new machine even the nuts and bolts are to be stainless. We recently described a catapult for enabling aeroplanes to land and take off in restricted areas. As air services develop the need for such measures is likely to become more pressing, and the problem is still engaging the attention of experts. The latest device, also a British invention, involves the fitting of slots and flaps to the wings. As the machine rises, the wings normally tend to lose "lift"; in the new device, however, the slots open as it gains height and the lift is thereby increased. The invention has just been tested in America with satisfactory results.

* * * * *

The discovery of prehistoric gold ornaments with other objects near St. Ives, Cornwall, adds another link to the evidence connecting Cornwall with Ireland in prehistoric times. Cornish legends frequently refer to intercourse with Ireland. With the faculty for incredible feats which is commonly reserved to their kind, several of the Cornish saints are reputed to have sailed from Ireland to Cornwall on a holy stone. Mythical incidents such as these suggest an uncertain memory of prehistoric times, when traders came in search of tin or were passing on their way to the Continent. Ireland was rich in gold and copper and its earliest metal weapons are of pure copper. It became, therefore, an important centre of prehistoric trade; and the crescent-shaped gold neck ornaments known as "lunulae," typical of the early Bronze Age in Ireland, have been found as far afield as Denmark and central Europe. The latest finds are ascribed to the middle or late Bronze Age, the date suggested being about 1200 B.C.

* * * * *

Evidence of the sacrifice of human beings and animals at the burial of an important chief at Nubia, in the Sudan, recalls the burial of the royal tombs at Ur. The discovery has been made by the Archaeological Survey in opening up a number of graves built by an Ethiopian race in late Roman times. In passages connected with one of the graves were the remains of strangled slaves, horses, camels and hounds, accompanied by harness and saddlery of silver. Groups of human remains, of which the necks had been discolated and the limbs broken, have been discovered previously in Nubia but without any clear indication as to whether they were the victims of sacrifice or punishment. The Egyptian custom of substituting models for living slaves to minister to the needs of their master in the next world is well known.

* * * * *

A device to enable blind persons to read ordinary type has been invented in France. When a ray of light shines on the type, each letter is thown into relief in another part of the machine, where it can be distinguished in Braille fashion by the reader. Braille type is at present unweildly and expensive, which is one of its disadvantages. The new device is called the photo-electrograph, and while it is likely to be an expensive luxury for some time, it will eventually offer the blind a far wider choice of reading than they at present enjoy.

* * * * *

The search for the Philosopher's Stone is not yet ended and the latest claim is made by a Polish chemist. He professes to obtain gold from sand, and recently demonstrated the process to a company of scientists in Paris—with what results it is not disclosed. It is to be hoped that he was successful, as he was under arrest on a charge of fraud and his release depended on the success of the demonstration. It involved heating the sand to a temperature of 1400° C., when the gold was alleged to appear and was expected to last for about three days.

French Art in the Middle Ages.

By Stanley Casson.

Mr. Casson deals with the mediaeval period in French art which has not received so much attention from other writers as more modern examples at the exhibition in London. An important new book helps the visitor to understand the significance of this period on which later developments have been based.

So much has been and will still be written about the works of art in the French Exhibition that belong to the last three hundred years, and the exhibits of those centuries are so numerous and so splendid that the visitor may be tempted to overlook the astonishing wealth of works of the earlier ages of French artistic history.

Fortunately, there has recently been published a magnificent volume that once and for all gives in reasonable space the facts concerning French mediaeval sculpture*, so that no one visiting the exhibition is now left to guess and speculate as to the nature and origin of the early phases of French art. From the fine series of photographs in this work we can now conveniently trace the beginnings of French Romanesque art, with its strong affinity to Byzantine prototypes and its underlying tradition of Gallo-Roman sculpture. The wealth of sculpture of the great ecclesiastical buildings of Moissac, Vezelay, Toulouse, Autun and many other places of vital importance show us how the main substructure was built up which culminated in the full Gothic period of Chartres, Lemans, Bourges and Auxerre. French art in these early times had a unity, despite strong local variations, which is not so clearly perceived in any other European country in the Middle Ages.

RELIQUARY OF JAUCOURT.
Byzantine silver-gilt of the eleventh century, supported by enamel and gilt angels of the fourteenth century. This is one of the finest examples of French enamelling to be seen in the exhibition.

Mr. Gardner has done a service to all students by putting at their disposal a corpus of material which must be used time and time again if the whole subsequent development of French art is to be understood. The fact that French artists of recent times lived among the monuments of the Middle Ages and were consciously or unconsciously affected by the strong sense of form and composition which the mediaeval artists possessed must be remembered when we are struck by the monumental character of the painting of Puvis de Chavannes, Ingres, Gauguin and Cezanne. Those painters lived in a land where form and fine balance of composition, and knowledge of the structure of any given scene were inherent in the art of all periods from the very first, and where a strong sense of colour was developed along special lines from the twelfth century onwards. In this context it is of great interest to see how rapidly the French artists took over and adapted to their own tastes the particular art of enamelling, whether in *cloisonné*, or in *champlevé*. Indeed, we can credit French artists with the first extensive development of enamelling from its limited use in Byzantine hands.

The Limoges school was the first great inventive development, while in the Rhine and Meuse valleys Byzantine traditions were more slavishly and less inventively followed. In the Exhibition the beginnings are well illustrated by a superb series of metal and enamel work in which colour and form are given the stamp of early French taste. The reliquary figure of St. Foy, from Conques, is interesting since it shows the barbaric style of tenth century France technically limited by Byzantine conventions but struggling to

**Mediaeval Sculpture in France.* By ARTHUR GARDNER. (Cambridge University Press. 73*s.* 6*d.*).

assert a character of its own. The enamelling is poor and slight, the metal-work good but crude. The general style of the figure, which is of gold plate on a basis of wood, strongly suggests the manner of Carolingian and German ivory work. The pierced crosses of the throne alone connect it with an interesting group of German ivories of about the same period.

The Reliquary of Pepin of Aquitaine, on the other hand, also from Conques, shows the art of enamelling more advanced, although the reliquary is no later in date than St. Foy. Here the Byzantine method of *champ-levé* is brilliantly continued but with new and brighter colours, suited more to the tastes of southern France.

How far the art of enamelling could get in a few centuries is seen in the lovely enamelled book-cover from the Cluny Museum, of the twelfth century, which is still Byzantine in general character but markedly French in its variations on the traditional composition of the Pantocrator. From this relatively simple technique to that of enamelling as a process in which enamel is used almost as paint is a big step, and the French artists of the thirteenth and fourteenth centuries must be credited, if not with its invention, at least with its perfection as a new and more permanent medium in art.

ENAMELLED BOOK COVER.
Byzantine style of the twelfth century, School of Limoges. From the Cluny Museum.

The finest examples in the exhibition are, without question, the famous Reliquary of Jaucourt. This delightful work is composed of an ancient and revered Byzantine reliquary of the eleventh or twelfth century originally made in the form of a flat box with a sliding top. Inside and out it is decorated with reliefs in silver-gilt in a good, but not in the best, Byzantine style. Worshippers of a later age decided that it was to be more suitably exhibited in its church, and in the fourteenth century it was given a basis of gilt-bronze supported by six small lions, and on the basis were put two angels in silver gilt and enamel, who supported the Byzantine treasure in their hands. The faces, hair and arms of the angels are enamelled in flesh colour with perfect skill and finish. The reliquary thus restored and rebuilt is one of the loveliest of the small exhibits, and a masterpiece of the art of the jeweller and the enameller of the fourteenth century.

The same tradition of lively and creative work is continued in the fifteenth century and perfected. The "Angel holding a Reliquary," which is of silver and silver-gilt, with painted or enamelled face and gilt wings, stands out as one of the most perfect of all the works of this century. The angel stands on a graceful pedestal and holds a crystal cylinder which once held some relic. The total height of the whole figure is some fifteen inches, and it comes from the chapel of the Order of the Holy Ghost.

Stone sculpture, so fully dealt with in Mr. Gardner's book, is well represented in the Exhibition. The early periods are represented by two figures from the Louvre, usually identified as Solomon and the Queen of Sheba. They come from the Abbey of Corbeil, now destroyed, and closely resemble the figures from the famous Royal Portal of Chartres. Probably they are slightly later in date and they are certainly more sophisticated than the figures of Chartres. In any case it is known that they must precede the year 1180 in date. These tall and stately figures show clearly how French Romanesque was emerging into the fuller development of early Gothic. They can rank as the most important sculptures in the exhibition.

The next century was one of free sculpture and greater experiment. Two figures from Rheims, musicians, show the degree of freedom which the sculptor had now attained and the restrained way in which he used his freedom. The faces are no longer the type-faces of the twelfth century but clearly the faces of contemporary Frenchmen. A head from a house in Rheims shows again how the sculptor was using his eyes and taking hints from the world around him.

The fourteenth century is represented by two good works. The Charles V comes from the portal of the church of the Celestins in Paris. Here is all the interest in drapery and attitude which marks the work of this age. The figure of Jeanne de Bourbon, from the same church, illustrates the slight diminution of grace which this century shows in female figures as compared with work of the close of the preceding century. On the other hand the works of the first part of the century, like the lovely virgin of the Sainte Chapelle, carry over the grace of the thirteenth century into the next. Both should be compared with the figure of Charlemagne on the sceptre of Charles V in gold, one of the finest pieces of metal work in the exhibition.

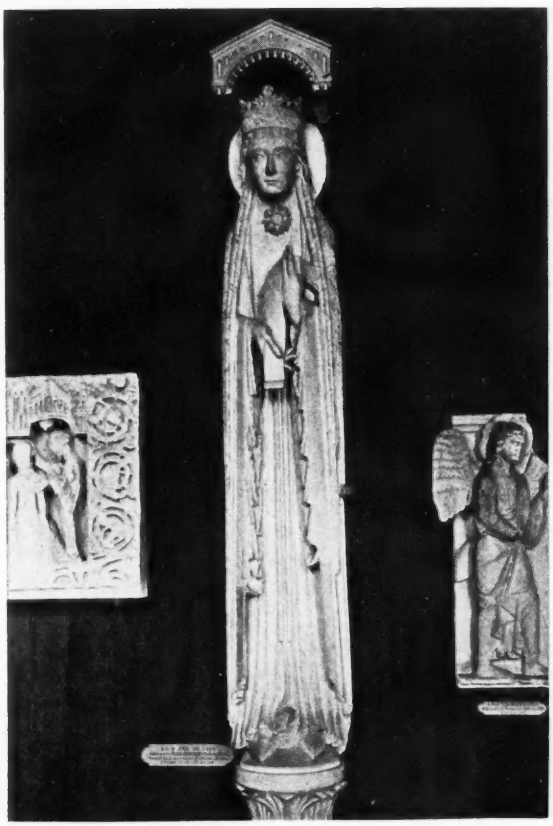
The fifteenth century marks a break with the past by virtue of the appearance of influences from Italy which were stronger and more decisive than any which had hitherto come to France. Most remarkable is an exquisite head of St. Fortunata, made as a reliquary. It is of pewter and shows to what extent Italy had begun to mould French style and so led the way to the wholesale Italianism of François I. This head is a perfect example of French vigour adapting itself to a new manner without losing its own native style. Indeed in the work of Renoir, Degas and Bernard one almost sees the same style and vigour persisting triumphantly.

With the aid of Mr. Gardner's fine volume it is possible to trace the earliest influences that went to build up the style of France and so to detect the undercurrents that affect later developments. The exhibition gives us ample material on a large as well as on a small scale for interpreting all periods. What is so difficult is to detect those elements which go to make up a style distinctive of race and history and setting in French land. The presence of so many mediaeval works of art which were accessible to poor as well as rich, must inevitably have contributed to keeping alive a style that was ingrained in national character. Just as one can distinguish at once a French from an English or a German mediaeval work so one can isolate a mode of approach in art which reappears in the painting of French nineteenth and twentieth centuries.

Nothing is harder than to analyse a national style of art, but the task becomes easier when there is available such a wealth of early material as France has to show. From the blend of Gallo Roman tradition—which appears at times even at a late date, as at Rheims—and Byzantine, came this new and lovely French synthesis that developed through a "Romanesque" period to the perfection of Chartres and Rheims and Bourges. By the fifteenth century French art had defined its style and its mode of composition. Subsequent centuries retained much of that synthesis: even in the work of Rodin you will see the traditional France coming out from time to time.

That most famous of all Rodin's monuments, "The Burghers of Calais," reveals quite unconsciously a good deal of the influence which the mediaeval monuments of France had had upon the sculptor; elsewhere in his work it is not so evident. In recent years the sculptor Bourdelle has consciously but still traditionally drawn upon ancient French Mediæval sources.

The photographs of the Reliquary of Jaucourt and of the Queen of Sheba are by les Archives Photographiques, Paris. The book-cover and the Angel Holding a Reliquary (on the cover) are puplished from the Palais du Louvre.



QUEEN OF SHEBA.
Among the most important sculptures is this figure of the Queen of Sheba, which originally came from the Abbey of Corbeil.

Exploring the African Lakes.

By E. B. Worthington, M.A., Ph.D.

Leader of the Cambridge Expedition to the East African Lakes.

As announced in last month's issue, a biological survey of hitherto unexplored lakes has just been completed in East Africa. A study of the fauna suggests that during the first and greatest of the pluvial periods, most of the great rivers of Africa had a common source in a huge lake which acted as a central breeding ground.

AFRICAN exploration as it was known at the end of last century is now a subject of the past, but there is still ample scope in the less known parts of the continent for treading ground which has not yet been visited by civilized man, and there is infinite scope even in the best known parts for exploratory work of another kind—the application of recent developments in the sciences of geography, geology and biology.

The subject with which I have been concerned during two expeditions is the study of the great lakes of Africa from the aspects of these sciences. Instead of exploring the sources of the Nile as they are to-day, we now explore their sources as they were during the pluvial periods, when the distribution of land and water over the African continent was very different. To this end various workers have brought evidence: Dr. Leakey and other members of the East African Archaeological Expeditions, during their study of prehistoric man in Kenya, have advanced wide generalizations concerning the pluvial periods. At the same time the admirable geological survey of Uganda under Mr. E. J. Wayland has produced other convincing evidence. During these periods there is no doubt that the drainage systems of East Africa as a whole were very different from their present condition, and the great lakes were much larger than they are to-day.

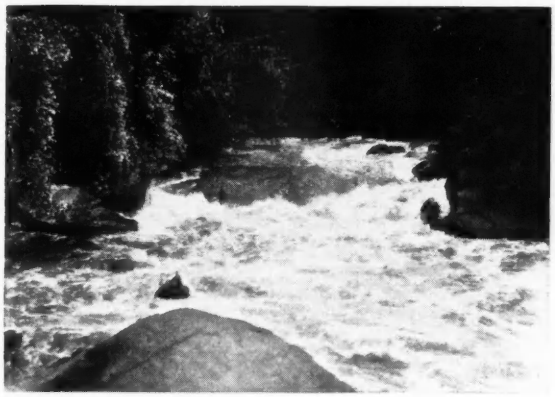
The Victoria Nyanza, for instance, extended further north and included the basin of Lake Kioga; Lake Albert is shown by high level beaches to have attained a level of 1,000 feet above that of the present; and in the eastern rift valley there were several great lakes, more or less uniting the small water areas of Lakes Naivasha, Nakuru, etc. There is, however, still some discrepancy between the views put forward by different workers; and now that we know the living faunas of the lakes in some detail, we can offer a useful check to the results of geological research by making comparisons of living faunas. In some instances we can show that changes have taken place which were unsuspected by geologists.

Some of the East African lakes are difficult of access by nature of their surrounding country and the lack of roads and railways. Before the last year's expedition several of them had never been crossed by boat, and a few had not previously had a boat on their waters. Thus we studied several stretches of shore-line which had not been visited before by Europeans, and in particular surveyed parts of the Lake Rudolf shore, including a unique volcanic island in the middle of the lake, which was very poorly indicated on previous maps. Another branch of geographical work has been to sound all the lakes, some of which, described as almost bottomless, have turned out to be quite shallow, and others, described as shallow and swampy, have proved to be exceptionally deep.

MURCHISON FALLS.

The Murchison Falls cut off Lakes Victoria and Kioga. They are the barriers to the movements of fauna in the Victoria Nile.

All the East African lakes are more or less alkaline, but unlike most other alkaline lakes in the world, the metallic ion is sodium instead of calcium, so that sodium carbonate is the most important salt in solution. Some of the lakes, in which there is a through current of water, are comparatively fresh; for instance, the Victoria Nyanza, which is drained by the Victoria Nile from its northern end, has a normality on the alkaline side of only 0.001. Compared with this the Albert Nyanza which is drained by the White Nile receives so



PART OF SEMLIKI FALLS.

The Nile system by no means contains the same fauna throughout its length. Another barrier is the Semliki Falls which cuts off Lake Edward.

much alkaline water from the River Semliki and from volcanic hot springs along its shores that its alkalinity is nearly ten times as much as Victoria. Other of the lakes, which lie in closed drainage basins, have attained a much greater concentration and are marked " salt " on the maps, although in point of fact salt in the restricted sense of NaCl is much less important than sodium carbonate in their waters.

Lake Rudolf is the largest of these closed lakes with an alkaline reserve of 0.023 normal. Its water feels decidedly soapy and is very unpleasant to drink unless neutralized by the addition of acid. There is no doubt that Lake Rudolf once had an outlet and was drained into the Nile system. This was during the largest pluvial period when the lake was at least several hundred feet above its present level. Since that time evaporation due to the intense desert heat and tropical sun has removed more water than has been received from rivers and rainfall, with the result that the lake level has slowly descended and the waters have been concentrated to their present degree.

This process has gone still further in the cases of Lakes Nakuru and Elmenteita which lie farther south in the Kenya rift valley. These are now small areas of water, with depths of less than 10 feet, but they represent the remains of a great pluvial lake. They are considerably more alkaline even than Lake Rudolf, and quite undrinkable. The final stage is Lake Magadi still farther south, a saturated solution of soda with deposits along its shores of considerable economic value.

There is still a mystery about Lake Naivasha in the Kenya rift valley. This lake has almost fresh water about the same alkalinity as Lake Victoria, yet it is also in a closed drainage basin and was once much greater in extent. The only reasonable explanation of this is that there is a subterranean outlet which causes a through current of water. The same is probably true of Lake Baringo, further north in the rift valley, which also contains fresh water although in a closed drainage basin.

The plant and animal life of all these lakes depends to a considerable extent on the concentration of salts in solution. In the most alkaline, for instance, there is no life except a profusion of minute plants which are devoured by shore birds, especially by flamingoes. The pink fringe to Lakes Elmenteita and Nakuru, formed by thousands upon thousands of these birds, is well known to anyone who has travelled up the Kenya rift valley by road or rail. The difference between planktonic faunas and floras of the lakes is a vast subject which has yet to be worked out in detail. We have now fairly complete collections, but the working up of all this material will be a matter of years. For present purposes I will confine myself to fishes which have bearings on the geological history of the region.

The Nile has two important sources in East Africa—the Victoria Nyanza, which is drained by the Victoria Nile over the Ripon Falls, through the swampy backwaters of Lake Kioga, over the Murchison Falls and so to the north end of Lake Albert ; and Lake Edward which is drained by the River Semliki to the south end of Lake Albert. Glancing at the map one might suppose that the whole river from the Victoria Nyanza and from Lake Edward to the delta would contain the same aquatic fauna. This however is not so, since in the course of the rivers there are barriers to the movements of the faunas—the Murchison Falls which cut off Lakes Victoria and

THE SHORES OF VICTORIA NYANZA.

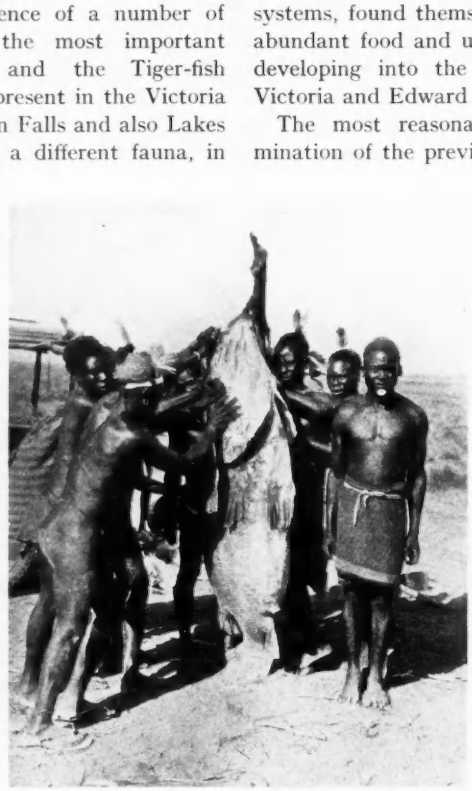
Victoria Nyanza was the first lake to be surveyed. Investigations in East Africa have now been completed by the work of the Cambridge Expedition.

Kioga, and the series of rapids known as the Semliki Falls which cut off Lake Edward.

The waters of East Africa as a whole may therefore be divided, according to their faunas, into two distinct types. In Lake Albert, the Lower Nile and Lake Rudolf there is one type of fauna marked by its variety and in particular by the presence of a number of genera of fishes, of which the most important are the Nile perch (*Lates*) and the Tiger-fish (*Hydrocyon*). The other type, present in the Victoria Nile system above the Murchison Falls and also Lakes Edward and George, has quite a different fauna, in which these genera of fishes are absent but in which other fishes, notably *Haplochromis*, have evolved a large number of species.

There is little doubt that at one time in the past all the great rivers of Africa, the Nile, Congo, Niger, etc., contained the same fauna, for now each of these rivers contains the same genera of fishes, although the species are as a rule distinct. The hypothesis was originally put forward by Günther that all these rivers had a common source in a great swamp or lake on the top of the African continent, which acted as a central breeding ground. Later, when subsidence occurred in the centre of the continent, this lake was cut off and each river was isolated so that the separate faunas evolved, each in its own way. Recent advances in geological knowledge have enabled the faunistic history to be fitted in with the geological history, but this is a large subject impossible to discuss here in detail. Suffice it to say that during the first pluvial period the great lakes were in direct communication and contained the same fauna. But as already mentioned the most important lakes—Victoria and Edward—now contain a very peculiar fauna, having a very large number of species belonging to a few genera. Almost all of these species are found nowhere else, whereas the Nile perch, Tiger-fish and a dozen or more other genera, very important in the Nile, Niger and Congo, are absent. The conclusion I reach is that during the first and greatest of the pluvial periods Lake Victoria and Lake Edward contained the same fauna as the rivers, and that this fauna was exterminated during the inter-pluvial arid period. Later, with the oncoming of another wet period, a few fishes which had survived the drought and a few others which re-entered the lake from nearby drainage systems, found themselves in a great water area with abundant food and underwent an adaptive radiation, developing into the present unique faunas of the Victoria and Edward Nyanzas.

The most reasonable explanation of this extermination of the previous faunas seems to be that the lakes in question dried up completely or to a few mud pools during the inter-pluvial arid period. There is ample geological evidence of such a drought in the deposits in both the rift valleys and in the neighbourhood of the Victoria Nyanza. During our last year's work we studied one of these beds laid down during the period of desiccation, which is exposed along the shores of Lake Edward. In this bed there is an abundance of bones, including those of the Nile perch and other fishes now absent from Lake Edward, which is sure evidence that Lake Edward formerly contained a fauna similar to Lake Albert and the Lower Nile. Similar fossil evidence with regard to Lake Victoria has not yet come to light, but it is a significant fact that among the very few fishes common to Lake Victoria and to the lower Nile are the well-known lung-fish (*Protopterus aethiopicus*) and the cat-fish (*Clarias mossambicus*), both of which are capable of withstanding long periods of drought dried up in mud.



GIANT NILE PERCH.
The Nile perch is one of the most important fish in Lake Albert, the lower Nile and Lake Rudolf, where many genera are found.

Limnology has passed through an interesting stage of development during the last twenty years. Whereas formerly it was concerned mainly with the collection and description of the various forms of life, now the organisms are studied more from the point of view of their relationships to each other than as separate entities. This involves a great deal of work such as the examination of internal organs, the study of stomach contents and so forth, and it is essential

that this work should be performed on very large numbers of specimens, so that the final conclusions are derived from the study of averages rather than from isolated examples.

In studying the biology of a little-known lake, or part of the sea, the work can be divided into several stages. Firstly, if the shorelines are not accurately charted they must be surveyed and mapped. Then comes the study of hydrography—sounding the water and charting its bottom—locating the deep holes and the shallow shoals: determining the variation of temperature and water chemistry at surface and bottom: measuring the depth to which the nightly mixing of the water takes place and whether or not a thermocline is developed. Then comes the study of the minute floating organisms—plant and animal: then the building up of "food chains." Thus in Lake Rudolf the *phytoplankton* is consumed by the *zooplankton*, the little minute fish called the *engraulicypris* feeds on the *zooplankton*, this in turn is eaten by the Tiger-fish which itself provides food for the great Nile perch. Finally come fisheries research which, apart from the initial field observations, is reduced to a study of statistics. In addition to the ordinary collection equipment, an essential part of the equipment for all this work includes reversing thermometers, depth water samplers and quantitative plankton nets.

A CAT-FISH AND ITS PREY.

Fisheries research involves the examination of internal organs and the study of stomach contents. The photograph shows a cat-fish with a *Tilapia* from its stomach.

In marine investigations Great Britain may be said to lead other countries, but in the study of fresh waters we have lagged behind. Until last year there were many fresh water biological stations in Europe, still more in the United States, but none in the British Isles. Now at last a fresh water biological Association has been formed in Great Britain and serious work has been started on Lake Windermere. There is some excuse in so far as the British Isles themselves are concerned, for our fresh waters are not enormous in extent and do not support great economic fisheries. In the colonies, however, there are vast areas of water of great potential wealth, as for instance the East African lakes, which offer excellent opportunities for fisheries development and for the creation of biological stations. It has been suggested from time to time that certain changes should be made in the fauna of our Colonies. Due precautions must be taken. Before introducing a fish to any lake a thorough biological survey should be made.

In the case of the African lakes biologists were mainly concerned with the collection of specimens until 1927, when a fisheries survey of the Victoria Nyanza was organized by the Governments of Kenya, Uganda and Tanganyika; an expert was selected from the Ministry of Agriculture and Fisheries of this country to take charge of the work. This was followed in 1928 by a similar survey of the Albert Nyanza and Lake Kioga. In 1929 a Cambridge zoologist did further limnological work on the smaller lakes of Kenya — Naivasha, Nakuru and Elmenteita—and during the last year the Cambridge Expedition to the East African Lakes has investigated Lakes Rudolf, Baringo and Naivasha in Kenya, and Lakes Edward, George Bunyoni, etc., in Uganda. Now, therefore, we may say that all the important Lakes of Kenya and Uganda have been investigated.

During all this work, modern methods of studying hydrography, plankton distribution and fisheries have by no means been neglected, but much of the work has been carried out in places which previously had never been studied, or from which only rough collections had been made. Therefore, as an essential introduction to ecology, complete collections of the aquatic organisms have as far as possible been made. These collections are to be deposited at the British Museum (Natural History), one of the scientific bodies in this country which made the recent expedition possible.

During the last year's expedition I was accompanied by Mr. L. C. Beadle as chemist, Mr. V. E. Fuchs as geologist, my wife as geographer, and for part of the time by Captain R. E. Dent of the Kenya Game Department.

*

Have Children a National Bias ?

By George H. Green, M.A., Ph.D.

University College of Wales, Aberystwyth.

To what extent are children naturally prejudiced against the people of other nations ? This interesting study has been the subject of investigation among schools in Wales. The results of the tests here described point to the urgent need of incorporating a study of social anthropology in educational theory.

A GREAT difficulty experienced by those who attempt to discuss racial or national bias in children is the obvious one of collecting enough facts to warrant generalizations. Another, equally great, is the result of the bias in the observer himself ; since probably few adults are less biassed in their attitudes towards members of racial and national groups, other than their own, than children are likely to be. Further, few observers can approach a study of this character without a belief of some kind, either that children, because of their limited knowledge and experience, cannot hold opinions about foreign peoples, or that on account of " innate " or " inherited " prejudices children are more biassed than adults.

Tests of Prejudice.

The desire to learn something of the facts and at the same time to escape the pitfalls enumerated led two members of the staff of the University College of Wales to draft what may conveniently be spoken of as " tests of prejudice " and to use them with rather more than four thousand children attending the primary, central and secondary schools of Wales. Schools of urban and rural types were chosen, situated in different areas, in order that the children tested might be regarded as a fair sample of the school population. Eventually, rather more than thirty thousand statements made by the children were secured ; and it is these which are the basis of the assertions which follow.

It was necessary before the tests were formulated to discover the racial or national groups which children would freely discuss, since it was essential—in order to discover whether prejudice is modified during the period of school life—to apply the same tests to children of all ages from seven to sixteen or seventeen. A few preliminary experiments, carried out in schools which were not used for the further experiments, suggested that children spoke with considerable confidence about Chinese, Negroes, the French, Germans, Italians, Spaniards and Americans. These, together with the British and the Russians, were the racial and national groups referred to in the tests.

The test itself was nothing more than a direct application of the famous saying, " You cannot indict a nation." It was an opportunity to indict, or to refrain from indicting, a people ; or, it can more correctly be said, it was a number of opportunities. All the children availed themselves of the greater number of these ; in other words, as far as these tests proved the existence of prejudice, all the children were prejudiced.

The test was divided into two parts, not merely for convenience, but to ensure, from the consistency between the evidence offered by the one and the other, that the child's answers corresponded with something consistent in his attitudes, and were not merely haphazard and random. In the first part of the test he was asked five questions of the form, " Which do you like better, Chinese or Negroes ? " In the second, a list of racial and national groups was printed at the head of the paper, and the child was asked, " Which of these people are brave ? Which are clever ? Which are stupid ? Which are cowardly ? " That is to say the " indictments " the child was invited to make were of two forms : he was asked to assert that certain peoples, on account of their racial or national origin, were preferable to others, and that whole groups of people, members of specified racial or national groups, were possessed of certain simple virtues or vices.

Each of these questions was followed by the further one, " What makes you think so ? " or " Why ? " And when the papers had been collected, the teacher of the class called each pupil to him individually, and asked in respect of every assertion made, " How do you know this ? "

The Evidence.

The evidence, then, on which the conclusions were based is of the following character : (i) A number of assertions about alien peoples and a number of preferences for one race or nation above another ; (ii) A number of statements which are alleged to justify the assertion or preferences ; (iii) Alleged sources of the " justifying " statements.

These alleged sources could be grouped under the following headings : school, newspapers, books, the home, experience, religious, institutions and the cinema. Of these, books were plainly the most

important, no less than half of the total " justifying " statements made being referred to them. Only rarely, in less than one per cent of the total, were references made to religious influences. The school, the home, newspapers, experience and the cinema were roughly referred to equally often, each of them accounting for about ten per cent. of the total.

The distribution of sources varies, of course, with age. Naturally enough, young children seldom refer to the newspaper and older children refer very seldom or not at all to the home, though girls continue to do so longer than do boys. Experience varies, since children in the Welsh seaports see foreign sailors daily, while the rural child is restricted to the sight of an infrequent Breton sailor peddling onions from village to village.

It was, of course, possible for children to refuse the test or to decline to answer it. Occasionally an elder child would write, " You cannot say that a nation is cowardly : some of the people will be cowardly but others will be brave." But the child who did this was never consistent : he did not hesitate to ascribe other virtues or vices to whole groups. He was willing to make some indictments, though not all. The difference between children of seven and children of sixteen appeared to be, not that the latter were less biassed than the former or that their prejudices were different in character, but that they showed greater ingenuity in defending them. Their wider acquaintance with books and with people, with newspapers and pictures had made it possible for them to " justify " their prejudices by assertions which satisfied the adolescent.

" Justifications."

The picture of racial and national bias in children which the enquiry presented, therefore, was that of a school population of children, already biassed at the age of seven by prejudices which would not materially alter in character throughout the whole of school life—prejudices so precious to the individual that he would pass from the " justifications " which satisfied him at one stage but where inadequate at another, to others which were satisfactory at the later stage. There was no reason to believe otherwise than that these prejudices might persist throughout the university years and after, " justified " by a body of " fact " gathered from every available field.

It is clear, therefore, that the test has not furnished us with any sort of account of the beginnings of racial prejudice, since we have found the youngest children to whom it could be applied—children of seven years of age—already fixed in their attitudes towards all the foreign peoples of whom they are able to speak. Until some other technique of equally general application has been devized, we shall have to fall back upon the accounts of the behaviour of individual children given us by various observers ; and these are seldom, below seven years of age, wholly reliable.

Attitude to Foreigners.

There is, however, another type of test which can be applied and may yield relevant information. Thus a small boy is asked in the course of a friendly general conversation, " Have you ever heard of a country called China, where the Chinese live ? " If he replies in the affirmative, the questioner proceeds, " Will you tell me some of the things you know about the Chinese ? " Each statement as the child makes it is written down, together with a note of the child's manner. The following is a sample of the results obtained from a single case of this kind : " The Chinese were the first people to be civilized " (*calm*). " They were the first people to make silk from the silkworm " (*calm*). Pause.—" They torture people. They are cruel " (*some excitement*). " They torture each other in battle " (*some excitement*). Another pause. The child's manner suggests that he is about to communicate some dreadful secret. When he speaks, it is in a lower tone, almost a whisper. " They pray to idols."

Then the statements were read over, one by one, to the child, and he was asked in respect of each, " How do you know this ? " He said that the information in the first two statements was communicated to him by his sister, who had been told it during a school lesson : the events mentioned in the last three had been seen on a film.

It is unfortunate that, in a matter of this kind, we have to take into account the subjective impressions of the observer. Another person conducting the experiment might have received totally different impressions of the child's manner. If we may rely on the recorded impressions, it is perfectly clear that the first two statements do not materially affect the child's attitude towards the Chinese, whom he clearly regards as wicked and cruel people. It seems likely, too, that he considers " praying to idols " as something even more reprehensible than torturing people. Possibly, then, evidence of this kind, if accumulated, might do something to help us formulate hypotheses of the way in which attitudes towards alien peoples originate.

It is urged by some people that racial prejudices are actually inherited as such. It is extremely difficult to conceive how this can take place ; and the fact of parents and children sharing strong colour prejudices,

for example, can generally be accounted for by the fact that the children are brought up and trained by people with such prejudices. Or again, it has been suggested that colour prejudice is the result of sen sitiveness to the body odours of coloured peoples. This again breaks down because strong prejudices of this kind are often manifested by people who are completely unaware of the existence of such odours.

"Good" and "Bad."

If, however, we examine carefully the statements made by children in connexion with the prejudice tests, we find that certain types of answer frequently recur. The negro is preferred to the Chinese over and over again, and is said to be kind because he works hard to grow bananas for us, or provides us with fruit which we cannot grow for ourselves. He is alleged, perhaps on the evidence of "Robinson Crusoe," to be faithful and dependable. The Frenchman is spoken of as kind, because he leaves his own country to bring us onions, and is praised because he "helped us," in the war. The German is kind and clever because he makes us such wonderful toys. Ultimately, it would seem, the peoples of the world fall for these young children into two sharp antithetical categories—the "good" and the "bad."

The first thing which strikes us is the similarity of all this to the material which was used so effectively during the war as propaganda. The "badness" of the enemy consisted in just this desire, we were told, to deprive us of the things which made life pleasant for us, and to hurt and kill us. The war propaganda, in other words, appealed to something in us which was firmly rooted in our infancy; it stirred up our infantile attitudes, our childish hates, and at the same time supplied us with materials for "justifying" them, so that we might indulge them to the full without shocking our rational selves.

The second thing which strikes us is the close resemblance of the "good" and "bad" people to the approving and punishing parents. The parents are, in the child's experience, the first people who, at the cost of some trouble to themselves, provide the child with pleasant food and toys, who carry out his wishes, who help and defend him. They are also the first people who deprive him of pleasant foods and toys and who on occasion deliberately inflict pain on him. The approving parents are the first people for whom he feels love: the punishing parents the first for whom he feels hate. The full development of this theme belongs to the psycho-analyst, and Flugel has worked it out admirably in his "Psycho-analytic Study of the Family." Though we may see the beginnings of love and hate in the infant's family circle and their relation to parental activities, and see very clearly their connexion with the racial and national attitudes of the child of seven years and upwards, it is by no means easy to trace adequately the intermediate stages. The explanation, it would appear, must lie in the way in which the foreigner is generally represented in the social culture of the group to which the child belongs.

It has already been said that references by the children to religious institutions were few. It should be added that the bulk of these were made to support bias against the negro or the Chinese. The reason is obvious: the missionary appeal represents the negro or the Chinese as an idolator or a heathen, often as a person who is hostile to the missionary—hence as a "wicked" man. School history lessons associate the Spaniard mainly with the Armada—the story of which, as generally related, makes him a coward—and with the Inquisition which emphasises his cruelty. In popular literature the Spaniard is invariably associated with the bullfight, and again represented as "cruel." Hence, as far as school children are concerned, the Spaniard is not a popular figure.

This study, therefore, even if it does not permit us to say a final word as to the causes and origins of the racial and national prejudices of young children, at least enables us to see that these are by no means simple. They appear to be attitudes which have their origin in the attitudes, developed from simple instinctive tendencies, towards the approving and punishing parents. They are transferred in ways which are made available through the traditional representations (or misrepresentations) of foreigners which are customary in the social group to which the child belongs. They persist because the child is seldom permitted to realize something about foreigners which he learns to realize in connexion with his parents—what we may call their "ordinariness. The child learns through experience that his parents are not the good and evil giants of the fairy legends but human beings.

Child Psychology.

He cannot learn this of foreigners while they are represented to him by means of obsolete and fantastic "national" costumes, by isolated though picturesque episodes in their national history, or by striking persons who are mistaken for types. And all this points to the urgent need of incorporating into educational theory, which rightly takes into account the psychology of childhood, the study of the social anthropology of our society.

Surveying in Northern Labrador.

By N. E. Odell.

Grenfell-Forbes Survey Expedition, 1931.

The work of the Grenfell-Forbes Expedition to Northern Labrador has provided material for a map which is to comprise about six thousand square miles of little-known country ; many serious errors in the existing charts will be corrected. Important additions to our knowledge of the botany and geology of the region have already been made.

SOME years ago Sir Wilfred Grenfell suggested to an enthusiastic yachting friend, Professor Alexander Forbes of Harvard, that he should devote a summer to a cruise along the northern coast of Labrador, whose scenery has been compared with some of the grandest to be found on the coast of Norway. In view of the uncharted and unsurveyed state of the region, and indeed the almost entirely unexplored character of the greater part of the interior, Dr. Forbes decided to make the cruise as much a scientific and surveying expedition as a yachting trip. Although the chief aim was to collect material for a map which will comprise about six thousand square miles, the expedition also provided scope for the botanist and geologist.

It was known from the reports of earlier visitors to the coast that the section lying between Cape Chidley, the northern point of Labrador proper, and Nachvak Fjord, a distance of about a hundred miles, contained some of the most spectacular as well as probably the highest mountains in all Labrador. The Torngat Mountains, or "Mountains of the Spirits," had been said to reach an altitude of eight to nine thousand feet, although more conservative estimates placed them between six and seven thousand feet. At any rate these mountains have been considered by most to hold the highest summits along the Atlantic coast of North America.

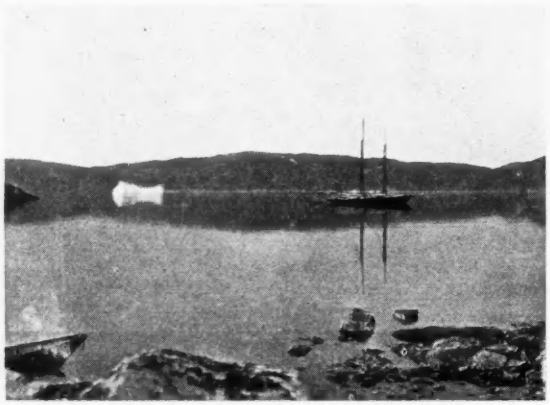
It was felt that here was an object worthy of investigation in itself, though it was also known from the visits of Professor R. A. Daly, Professor A. P. Coleman and R. H. Woodworth, among others, that a great deal of geological, glacial and botanical interest was awaiting adequate investigation. Such questions as the age of the Torngat Mountains, whether or not they were entirely submerged during the Ice Age, the character of the flora of the region and its bearing upon the question of ice submergence were all problems awaiting solution. The work of charting the coast except purely locally was naturally beyond the scope of a small expedition, and in view of the intention of the Admiralty to commence this great work in all probability next year, very little in the way of sounding except locally was worth attempting. The nature of our work afforded plenty of climbing, in the course of traversing various peaks. These included the Bishop's Mitre and Mount Razorback, mentioned later.

Dr. Forbes secured as expeditionary vessel a 97-ft. schooner, which had already been used in oceanographical work, had her completely refitted and provided with a new auxiliary motor, renaming her the *Ramah*, after the Moravian Mission station of that name in the Torngat country. The vessel left Boston early in June, but the main rendezvous of the expedition was St. Anthony in northern Newfoundland. The company on board sailing thence on 2nd July numbered sixteen, of whom four, including the writer and his wife, had come over from England. In addition were two seaplanes, with an aerial section numbering four persons, to assist in the topographical survey by means of aerial photography.

MEETING IN LABRADOR WATERS.

As the *Ramah* was leaving the extreme north it had an unexpected meeting with the hospital ship of the Grenfell Association.

The voyage up the coast of Labrador must ever be an interesting one, but to the *Ramah's* company perhaps particularly so, since our skipper, Dr. Forbes, was piloting his own vessel along what may be one of the stormiest coasts anywhere to be found, full of reefs and uncharted rocks, where one can sail through islands and over headlands, and where opinions differ as to the true position and extent of numerous



THE *RAMAH* IN CAPE MUGFORD.

After touching the more important settlements on the Labrador coast, the vessel sailed to Cape Mugford, where the Kaumajet mountains were explored.

bays and inlets. In order to conserve our fuel we proceeded at times solely under sail, and the ship's company were the deck-hands and crew.

After touching at the more important settlements on the coast, including those of the Grenfell Association in the south and the Moravian Missions in the north, at each of which we received a warm welcome, the vessel made its way northwards to the neighbourhood of Cape Mugford, where is situated the fine coastal range of the Kaumajet Mountains. This was a most profitable visit, both to the botanist and the geologist of the party, for the day was spent in exploring some of these fine mountains, which were very reminiscent to the writer of the Lofoten Islands of Norway. Later, on our way south, another day in this neighbourhood gave three of us an opportunity of making the first ascent and traverse of the Bishop's Mitre, about 3,750 feet in altitude, and a strikingly prominent point on this part of the coast.

Proceeding northwards and frequently feeling our way in thick fog along this intricate coast, we eventually found anchorage in a cove of Kangalaksiorvik Fjord (meaning " the fjord where they go to hunt the reindeer when their hair is off "), also known as Seven Islands Bay. The spot, later known to us as " Seaplane Cove," was especially chosen by O. M. Miller, the surveying expert of the expedition, as suitable for the triangulation constituting the ground control of the aerial survey, as well as one affording a sheltered anchorage for the seaplanes. Here we were in the heart of the wild Torngat Mountains, now quite uninhabited by Eskimo, and to our north across the fjord rose the much discussed " Four Peaks," which now appeared to be a group of fourteen if not forty peaks ! Our survey later showed, though the computations are as yet incomplete, that neither they nor any other summits of the Torngats exceed five thousand feet in all probability. While the topographical survey, both triangulation and aerial, was in progress with Seaplane Cove as a base, the writer's party scoured the mountainous country of the interior, and from a camp situated about twenty miles inland, on the shores of a large loch-like lake, a geological, glacial, and botanical survey of the region was made. In this district, and further north than many authorities suppose, were found excellent salmon which were a welcome addition to our camp fare, but no caribou were seen and mammals of all kinds were singularly absent. The rocks of this region were found to be of Archaean Age, contemporaneous with those of the great Canadian Shield of Quebec, Ontario, and Manitoba. There was evidence that during the last great ice sheet of the Glacial Epoch, whose centre was situated somewhere in the interior of the south-west, most if not all of the highest summits were completely inundated, and that great glaciers flowed outwards through the mountains to the sea. To-day there are but dinimutive and waning remnants of these glaciers to be found high up in the mountains. E. Abbé, the botanist, in studying the presence of the alpine types of flora, or in demonstrating their absence, was able to throw some light on these matters affecting the former extent of the ice sheets.

During the second week in August, following a brief visit to Ryan's Bay just north of the " Four Peaks " group, a move was made to a region some fifty miles in all to the north, where in the neighbourhood of a large unmapped inlet named Ekortiarsuk, within

CAMP NEAR KANGALAKSIORVIK FJORD.

After passing through thick fog the vessel anchored at Kangalaksiorvik Fjord meaning " the fjord where they go to hunt the reindeer when their hair is off."

twenty-five miles of Cape Chidley, another anchorage served as a base for further inland operations. A remarkably fine spell of weather enabled a rapid examination of the district to be made, and a further triangulation was carried out for the better control of the general survey. From a mountain about 2,800 feet in height, which proved to be the highest in this northern extremity of Labrador, a most commanding view was obtained of Hudson Straits and the Button Islands northwards, of Ungava Bay to the west, and even the dim outline of Akpatok Island, ninety miles distant, whither the Oxford Expedition was bound; whilst eastwards the blue sweep of the Atlantic for many a league was flecked with infrequent icebergs borne visibly along on the Labrador current.

With the completion of the field work in this region, we were provided with data for our map which is to comprise approximately six thousand square miles of the northern peninsula of Labrador, and will correct many errors commonly displayed on the few existing maps and charts of these parts. Moreover when all results are fully worked out there should be considerable additions to our knowledge of the solid and glacial geology as well as the botany of the region.

As we were leaving the extreme north and making our way in perfect weather down the coast, we were delighted to see approaching the long-expected *Strathcona*, the hospital ship of the Grenfell Association. It had been hoped that Sir Wilfred Grenfell would have been able to participate in the activities of the expedition, but he had been delayed in his round of visits along the coast in the south. We now proceeded southwards together, visiting again Kangalaksiorvik,

IN THE KAUMAJET MOUNTAINS.

The fine coastal range of the Kaumajet Mountains is situated at Cape Mugford. Here both the botanist and geologist paid a profitable visit.

ESKIMO HUNTERS.

A brief visit was made by the expedition to Ryan's Bay, just north of the "Four Peaks" group. The local Eskimos had seen the seaplane overhead.

in order to complete various items of work, and then paid a visit to the renowned Nachvak Fjord, one of the largest and most beautiful on the coast, prior to our final departure south.

An expedition in the latter district which occupied the writer and his assistant, Brewster Morris, during a strenuous sixteen-hour day was the traverse of Mt. Razorback, whose jagged crest rises 3,600 feet on the north side of the entrance of Nachvak Fjord. Not only did this truly alpine expedition afford all the variety of first class rock climbing and ice-craft amidst scenery of the highest order, but some valuable geological and glaciological results were in addition obtained.

Here and further north the Torngat Mountains would provide ample scope for the enterprising mountaineer who is seeking new worlds and virgin peaks to conquer, and who delights in a region remote from the crowded mountain resorts. Moreover in this far north land, with a character in many respects all its own, he can pursue studies with ample original material at his disposal, whether in natural history in its many aspects or in archaeology anent the early Tunnit race, whose remains are scattered at infrequent intervals along the coast, or in anthropology at the Eskimo settlements. At the latter and the Moravian Mission stations, as well as at the Hudson Bay Company's posts, if he ventured no further, he will find hospitality and a welcome such as only this cheerful, kindly people of the north can offer. And access to all but the extreme northern part of Labrador is easier than many suppose. The Newfoundland Government steamer usually makes two or three trips as far as Hopedale or Nain during the summer.

A Romance of Modern Chile.

By John Benn.

A clerk who began work at the age of eleven has left a fortune to found a college at Valparaiso. Its influence on the future of the country is discussed by the Editor, who visited Chile during his recent tour. Some quotations are made from the "Chilean Review."

CHILE has been much in the public eye lately on account of the nitrate situation. The monopoly which her natural nitrate long enjoyed was destroyed by the discovery of synthetic nitrate, which is being extracted from the air in increasing quantities every year, both in Europe and the United States. The position was described in *Discovery* last May in an account of the Maria Elena nitrate fields. The national company known as "Cosach" was at that time under discussion; it has since been officially formed and favourable prospects are foreshadowed for the new Guggenheim process.

Research on Nitrate.

Meanwhile, it is clear that the economic future of Chile depends on the extent to which the country can adapt its resources by technical improvements so as to compete with the synthetic nitrate. The latter is still relatively costly to produce, and the natural nitrate has many advantages to offer for agricultural use as it contains iodine and other valuable ingredients. To balance the heavy shipping charges which are at present its principal handicap, the closest attention is being given to production costs. Here the chemist and technologist are playing an increasingly important part.

Another result of the slump in nitrates is the development of local industries in Chile. Until recently the majority of the population existed by exporting minerals, there being, of course, rich copper mines in addition to other resources. Widespread unemployment has followed the closing of superfluous nitrate fields throughout the country, and new industries are being developed with the aid of tariffs. Several British companies have established factories in Chile with considerable success, and American enterprise is represented by the Curtis-Wright aeroplane works at Los Cerrillos. There are already several thousand workshops and factories throughout the country, and the need for trained engineers is growing every month.

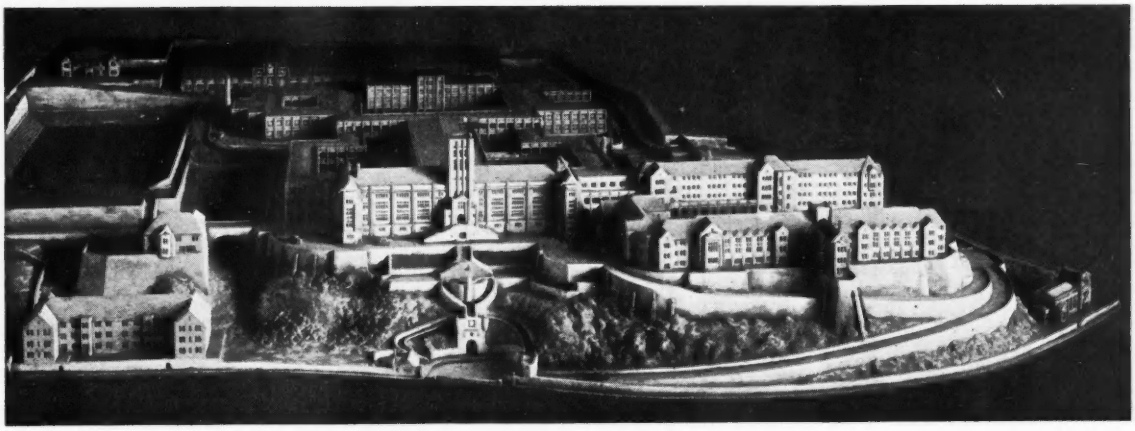
The fact that the country is passing through a period of transition is indicated by the strikes and "revolutions" of the past year. The unskilled labour of the mines is not always suited to factory conditions, but it would be a mistake to attach too much importance to these disturbances, which are often exaggerated in the Press reports. Confidence in the future of this market as a whole was impressed last month by the Prince of Wales, at a meeting held in London to commemorate the anniversary of his tour through Latin America in the spring of 1931. Chile is suffering from world depression and when trade revives in other countries the position should greatly improve.

All these factors give special significance to the new technical school at Valparaiso, which promises to be the most up-to-date institution of its kind in Latin America. "The Carrera School of Arts and Crafts and College of Engineering"—to give its full title—was formally inaugurated on 20th December, 1931, the guiding spirit in the enterprise being Don Agustin Edwards, the well-known banker and former Chilean Ambassador to Great Britain. The buildings were making rapid headway when the writer was shown over them last spring, and the accompanying photograph gives an impression of the magnificent scale on which the college will be finished. Valparaiso is built on hills surrounding the bay and the new college stands on a promontory facing the open sea. It will be a long time before its full influence is felt, but there can be no question of its importance to the future of the country.

The history of the Carrera College illustrates the progressive outlook of the Chileans to-day and throws further light on the rapid changes that are taking place throughout South America. The word *manana* has so long been associated with the Spanish-speaking peoples that an impression of fatalism still prevails, though it no longer represents their outlook. The new spirit is clearly shown in the following extracts from the *Chilean Review*, which are quoted by special permission.

A Remarkable Citizen.

It is pointed out that the technical school owes its foundation to one of the most remarkable citizens of Chile. Federico Santa Maria y Carrera was born in Valparaiso in 1845, and after a few years at a school kept by a German named Scholler, he began, at the age of fourteen, a commercial career which was to prove brilliant. It opened humbly with a



THE CARRERA SCHOOL OF ARTS AND CRAFTS.

This model of the new college shows how the buildings are grouped, the offices and library being in the centre and the laboratories behind. The stadium is on the left.

clerkship worth eleven *pesos* a month. But Santa Maria lacked all the qualities of an employee. He showed very early his enterprising, dominating spirit, and before he had left his teens he had bought a barge and was earning his living as his own master. Before he was fifty he had amassed a large fortune.

Then he called a halt. This son of the New World wished to see other countries, and from 1894 he spent three years globe-trotting. He travelled to India by way of Europe, and it was Europe which became his final home. In 1897 he settled in Paris, and remained there, save for a journey to Chile in 1906, until he died in 1925.

This last quarter century of his life was occupied by almost feverish activities on the Stock Exchange, except for the four War years, during which he devoted his energy entirely to the service of the Allies. Before 1914 Santa Maria had already attained the powerful position of "Sugar King" of the world. Of the steps which led to that throne, his biographer, Don Agustin Edwards, says: "The activities of Santa Maria were kept within the limits of a strict observance of law and of the most honoured commercial principles. It was not machinations or frauds which won him his triumphs, but his admirable fore-knowledge of the factors which determine a rise or fall, his valour in undertaking operations which would, by the amount they involved, have confounded anyone who lacked his passion for risks, and his imperturbability in face of invective, however formidable its origin."

The "Fundación Santa Maria" owes its being to Federico Santa Maria's will, dated 1920. In it he states that having no legitimate heir, he had, in 1894, bequeathed his fortune to endow a university in Valparaiso. "But," he continues, "experience showed me that this was a mistake, and that it was important to elevate the workman of my country, conceiving a plan by which I would, first, contribute my mite to infancy; secondly, to primary schools; then to a School of Arts and Crafts; and finally to a College of Engineering, thus bringing within reach of the deserving poor the highest degree of human knowledge, since it is the duty of the well-to-do classes to contribute to the intellectual development of the proletariat."

In fulfilment of this intention, Don Federico bequeathed all his fortune in trust to Señores Agustin Edwards, Juan Brown Caces, Carlos Van Buren and Andrew Geddes, to be applied "to the creation and establishment in Valparaiso of the following institutions:

"(*a*) A School of Arts and Crafts, to be both a day and a boarding school. Only those pupils shall be admitted as boarders who have distinguished themselves in the primary schools by their intelligence and industry. Further, from each province of Chile two or more pupils shall be admitted who have, in the judgment of the directors of the provincial primary schools, distinguished themselves in those institutions. Instruction, board and lodging and clothes shall be supplied free of charge. There will be separate rooms in the boarding-house for the pupils who have most distinguished themselves in the School of Arts and Crafts and whose gifts are such that they deserve to continue their studies in the College of Engineering. No pupils whose parents are well-to-do shall be admitted as boarders, although they may matriculate as day pupils of the school and the college.

"(*b*) A College of Engineering in all its branches, civil, railway, factory, mining, hydraulic, electrical,

etc., and all other branches which progress may introduce. The boarders of this college shall be in the boarding-house of the School of Arts and Crafts, and shall include only pupils considered suitable by the Board of Management. They may emanate from the School of Arts and Crafts or from other schools, provided they lack resources with which to continue their studies. There shall also be a boarding-house for pupils in general.

"Secular" Instruction.

"Both in the School of Arts and Crafts and in the College of Engineering, instruction shall be essentially secular, and all religious instruction shall be prohibited since it can be given by parents in the pupils' homes. Both these educational institutions, and any other institution which may be founded later, must add to their names the name of José Miguel Carrera, in homage of the great patriot who raised the cry of independence in Chile, and as a lesson to the pupils that they owe themselves first to their country."

The founder further provides in his will that the teaching staff of both establishments shall be "composed entirely of foreigners, without distinction of nationality, chosen and engaged by one of my trustees, who shall for this purpose go to the United States or Europe in order to inform himself carefully of the scientific and pedagogic capacity of each one." This provision is binding only for the period of ten years, after which the teachers may be either Chilean or foreigners.

There was no delay in putting his magnificent scheme into practice. The designing of the building was thrown open to competition, and the successful design was submitted by two Chilean architects, Smith Solar and Smith Miller. They were commissioned to visit all the principal technical schools in Europe and the United States. Armed with this special knowledge they returned to Chile in 1928 and the building was set on foot. The plan on which this work is now proceeding is for a group of buildings occupying an area of some 74,000 square metres. A central block includes the principal entrance, the administration building and the technical library. Behind this are the lecture theatre, the cloisters and the classrooms, with the laboratories and the aero-dynamics pavilion. At the back of all stands the great workshop which covers an area of eight thousand square metres. Two side blocks comprise on the one hand the boarding-houses of the students and on the other the great stadium and the rector's residence. House for the staff will be built on either side of the principal entrance. The provision of a separate department for aviation is notable, as flying is making steady progress in Chile. For some years past there has been a regular service of passenger machines from New York to Valparaiso, the journey being made in five days compared with sixteen by sea. Weather conditions on the west coast of South America are ideal for flying, as rain is very rare, even in the winter months. At present these air lines are mainly operated by Americans, but there are already two Chilean companies in the field and Chile has an up-to-date air force. In other parts of the continent the prospects are equally favourable and the Chileans are evidently determined to be well ahead in aviation.

As in the case of the architects, the selection of the teaching staff for the college has been the subject of exhaustive enquiry. After studying the facilities for scientific training in various countries, the Trustees came to the conclusion that Germany could best fulfil the standards provided for by the founder's will. Applications were invited from all parts of Germany and Don Augustin Edwards personally took part in examining the candidates for the various professorships. He laid special stress on the all-round qualifications of the men, so that the staff should be fitted for the social life of the new college. The appointments have been made subject to a knowledge of Spanish, and the professors are now studying the language of their adopted country. Don Santa Maria recognized that the necessary talent was not available in Chile to staff the college at the outset, and the selection of Germans, though his late enemies, is a tribute to the impartial way in which the will is being administered.

Don Frederico's Ideal.

Some years must necessarily pass before this grandiose scheme has been fully executed. "When the School of Arts and Crafts and the College of Engineering do at last stand in Valparaiso," the *Chilean Review* concludes, "they can hardly fail to realize the ambition of their founder. To Don Federico Santa Maria, affectionately remembering, amid his financial activities in Paris, the city of his birth, it seemed that it contained too many offices, too many lawyers, doctors, architects and clerks. It seemed to him that this black-coated class was ill-fitted to take advantage of the growing tendency of the modern world towards industrialization and mechanization. He scheme that the citizens of Chile should become supreme among the engineers, mechanics and skilled artisans of the world. This was the distinction which he sought to confer upon the land of his birth."

The Economic Background in Manchuria.

By L. Dudley Stamp, D.Sc.

University of London, London School of Economics.

What are the root causes of the struggle between China and Japan? Dr. Stamp attempts to answer this question in the light of economic and geographical factors, giving a vivid picture of conditions in Manchuria to-day.

MANCHURIA is a vast tract of more than a third of a million square miles which lies between latitudes 39 and 53° 30′ North on the eastern side of Asia. To the north and north-east, on the other side of the River Amur, lies the territory of Soviet Russia. To the south-east lies the Japanese possession of Korea. On the west the boundary is ill-defined and Manchuria fades into the semi-desert plains of Mongolia. The link with China proper is a narrow neck of low land between the mountains and the sea at the Gulf of Pechihli, whilst Manchuria itself has a sea border along this gulf and along the Peninsula of Liaotung.

Comparison with Canada.

In many ways Manchuria can be compared with the heart of Canada. The centre of the country is occupied by rolling grassy plains, naturally treeless over most of their extent, closely resembling the prairies of Canada. To the east is a great belt of ancient rocks giving rise to forested mountains which are at the same time rich in minerals—in coal and iron as well as in various metallic minerals. To the west lies the great scarp of the Khingan Mountains and beyond these the Mongolian Plateau, so that again a comparison with Canada is suggested, with the Rocky Mountains to the west of the prairies and the ancient rocks of the forested area of the Canadian Shield to the east. The southern portion of the plains is drained by the Liao River and Mukden is the natural centre of this tract. Further north the drainage is northwards, and the centre of the northern part of the great plains is the town of Harbin.

Climatically Manchuria can also be closely compared with Canada. There are the same bitterly cold winters as one finds on the Canadian prairies. The average January temperature at Harbin is about zero Fahrenheit, which may be compared with the —4°F. found in the same month at Winnipeg. The climate of the winter is by no means improved by the very strong and bitterly cold winds which sweep down from the cold heart of Asia. In summer the average temperatures are high. In July the average over a large part of the plain is about 75° F., or 15 degrees warmer than England at the same period and on the whole rather warmer than central Canada. The comparatively light rains of the country come in the spring and summer months, being brought by monsoon winds from the China seas and the Pacific Ocean. These rains, light as they are, come just at the season when they are of the greatest value agriculturally. Broadly speaking one may say that whatever agricultural developments are possible in the prairies of Canada are possible also in the prairies of Manchuria, and whatever developments are possible in Canada as a result of the presence of forested and mineral-bearing tracts are also possible in Manchuria. In one respect Manchuria is more fortunate than Canada, for the central plains reach the sea and on the Liaotung Peninsula the port of Dairen, having an average temperature in January of 24 degrees, is free from ice throughout the whole year, so that there is an entrance to and an outlet from the country which is never blocked.

Such is the country of vast potentialities which has become the bone of contention between three great modern nations—China, Japan and Russia. The name Manchuria, or Land of the Manchus, indicates its connexion with China; for China was conquered and ruled by the Manchus, who sat at Peking as their capital from 1644 till 1912. They were originally a tribe of nomadic people, whose life on the Manchurian prairies may be compared in some respects to that of the American Indians on the Canadian prairies. Like the American Indians, the Manchus have practically disappeared from Manchuria except for a few scattered groups in the far north. It was natural, however, that the homeland of the conquerors should thus become linked with the land of China which they conquered, and Manchuria became the viceroyalty of the "Three Eastern Provinces," and was thus handed down as a legacy to the present Chinese Republic which succeeded the Chinese Empire on the fall of the Manchu dynasty in 1912.

Economic Aspects.

The struggle of both Russia and Japan to gain possession of the Liaotung Peninsula and the open water port of Dairen reads merely as a political intrigue or as an attempt of two nations at empirical aggrandisement unless one realizes the economic background. The bare facts, which are often presented as if they were the whole story, are that

A MODERN HOSPITAL.

The modernization of the country owes much to the South Manchuria Railway, which has been largely responsible for the magnificent schools and hospitals.

Japan, after the Japan-Chinese War of 1894-95, claimed the peninsula of Liaotung. If one glances at the map one sees that it is not only the entrance to Manchuria, but it also guards the approach to Peking from the sea and was literally " a pistol levelled at the Chinese capital." By the intervention of European Powers, Japan was therefore baulked of her attempt to control the peninsula, but a few years later (in 1898) Russia by intrigue gained possession of a lease over the area. This lease passed to Japan as her prize after the Russo-Japanese War in 1904-5. But in the struggle for rights in Manchuria it would seem that the historical facts of the case do not provide all the necessary facts.

The desire of Russia, after her enormous expansion right across Asia to include the whole of Siberia, to gain an open water outlet to the sea is obvious and natural. Her own port, Vladivostok, which is at the end of the Trans-Siberian Railway, is closed by ice for several months of the year, and Russia is in the same position as Canada would be if she were robbed of the Maritime Provinces with the outlets of Halifax and Saint John and had to depend entirely for her winter outlet on the southern route via New York. But it cannot honestly be urged that Russia has a *prima facie* need either of the territory or of its resources, provided she is guaranteed the necessary outlet to open waters. There remains the question of the relative claims of China and Japan to the territory.

According to the census of 1931 the population of England and Wales is approximately 40 millions. In the same year the amount of arable land was 10 million acres, or one acre to support four persons. If one adds to this the area under permanent pasture the total is about 25 million acres, or one acre per 1.6 persons. With these agricultural resources we in England are only able at the present time to produce about 30 per cent or less of our essential food requirements. England solved the problem by becoming an industrialized nation. This she was able to do by the possession of vast resources of coal and iron—resources which may still be regarded as a necessary basis for industrialization. Other less bulky but more valuable raw materials may be and are imported from abroad. For example, we import in this country our cotton and our wool for our great textile industries. Britain has thus become a supplier of manufactured goods to the world, enabling her to pay for all her imported foodstuffs.

Turning now to Japan, Japan is a nation with 60 million inhabitants, a number increasing with remarkable rapidity by approximately a million a year. There are in Japan proper 14 million acres of arable land, or of arable land and permanent pasture together 19 million. The latter figure is equivalent to less than one acre per three inhabitants ; but even allowing for a lower standard of living and a smaller consumption of food per head, Japan is obviously in a far worse position than we in the British Isles. The only solution for Japan is thus to become an industrialized nation, and to become, as she has attempted, the England of the East. But this necessity was thrust upon Japan with her increasing population at a time when many other nations of the world had already become industrialized.

Japan's Problem.

Japan lacked also the essential basis for the change. Her coalfields are small and poor and she has practically no resources of iron ore. Of raw materials for the major industries of the country at present, the raw silk is largely home produced, the raw cotton has to be imported just as it is for Lancashire. Japan was, and is, literally a nation faced with starvation or extermination unless a solution of this problem can be discovered. There was, and is, an obvious solution ; for facing Japan on the mainland of the continent of Asia is this vast territory capable of producing on her undeveloped acres the very foodstuffs necessary for the life of Japan and at the same time having a wealth of coal and iron on which Japanese industry could be built up. Japan has, therefore, proceeded to pour money and brains into Manchuria and to develop the country.

Again one may draw a comparison with Canada. The development of Canada was only possible by such railway enterprise as the great work of the Canadian Pacific Railway. Everyone knows that with its fleet of ocean-going liners, and vast interests

in land and irrigation, it is far more than a mere railway company. Its equivalent in Manchuria is the South Manchuria Railway, a company with a capital of £44 million sterling (440 million yen). But only part of this huge capital is actually concerned with railway development and railway work; for the Company owns and runs steamship services and the docks of Dairen, the great outlet of Manchuria. It exploits the coal and iron. It has made possible the agricultural development of the country and has at the same time paid due attention to the mental and moral welfare of the inhabitants.

Modernizing Manchuria.

The educational and health services of Manchuria, the magnificent school and hospital buildings, and the planning of the towns has been largely the work of this corporation. It stands out as the pre-eminent example of the influences which have really been civilizing and governing Manchuria for the last quarter of a century. The capital of the South Manchuria Railway Company is mainly Japanese owned, though there are some Chinese shareholders. The Japanese Government has a voice in the appointment of the railway company's officials. Thus Japan by the exercise of what is quite definitely a modernizing and civilizing influence has tried to secure for herself from Manchuria a supply of foodstuffs upon which the life of her people depends, and raw materials.

China proper is a vast territory of over a million and a half square miles with a population estimated at no less than 400 millions. But a large part of China is mountainous, and the mountains have long since been stripped of their trees and are barren and almost useless, so that of necessity the vast population of China is concentrated on her comparatively limited fertile plains. There the congestion can only be described as appalling. The Chinese remain essentially agriculturalists, and when one talks about the density of population in China one means, of course, the density of a rural population which is finding its sustenance in that area in which it actually lives. In some of the more fertile alluvial plains of China the density of population of this character actually reaches 3,000 to the square mile, in addition to a thousand animals. It follows almost automatically that a very large proportion, one cannot say exactly how large a proportion, of the whole Chinese nation is living on the verge of starvation. A failure in the harvest may easily result in the death of almost untold thousands, even millions, by mere starvation; yet to a very considerable extent social and religious customs tie the Chinese to the soil of their birthplace—the unity of the Chinese family, the age-old ancestor worship combine to keep the Chinese family together and to prevent migration.

Millions upon millions of Chinese would not move from these conditions even if the opportunity offered. This statement is very often made, but it must not be exaggerated. From the south of China—from the sea-board where broader views prevail—immense numbers of Chinese emigrate every year. They are rapidly populating Malaya and the East Indian archipelago. For the Chinese in the crowded north there is equally the need of an outlet, and there the Chinese have been increasingly attracted in recent years by the vast prairie lands of Manchuria. It is true that part of the migration is only seasonal, that the agricultural workers go into Manchuria for the six summer months and return to their ancestral homes to pass the winter; but increasingly there is the tendency for the migration and settlement to be permanent. Hence the Chinese population of Manchuria at present is certainly over 25 million and the number of migrants has reached the stupendous figure of a million in several recent years.

It is these Chinese migrants who are cultivating the 80 million or 90 million acres under the plough in Manchuria; it is they who on a quarter of this area produce the beans that now constitute the principal export of the country. Over more than 7,000,000 acres they grow wheat for themselves and

TREELESS PLAINS.

The familiar water buffalo of the warmer southern parts of China is actually less common in Manchuria, for there fields of wheat replace flooded rice fields.

a surplus for export. Still there are boundless lands available for further development. The pioneer work of the Chinese farmer in Manchuria has been made possible by the stable government and tranquil conditions which have prevailed in the country. The stability of government has been partly maintained by the Chinese war lords responsible rather in spite of conditions in the remainder of China than as a result of any control from Nanking; whilst the other stabilizing influence in the country, the Japanese influence, has already been stressed.

That China is in dire and urgent need for this outlet for her surplus population is without question; though it can scarcely be claimed that China has the same urgent need of the coal and iron, which are the other great products of Manchuria, for China herself has vast coalfields practically untouched. Probably the coalfield underlying Shensi and Shansi in China proper rivals in size and importance the largest in the North American continent, the coalfield of Pennsylvania. Similarly China has abundant iron. What is really needed in China is the development of railways and communications whereby these resources can be tapped, and that presupposes a strong central government standardizing Chinese weights and measures, suppressing local taxation and undertaking a definite economic policy. Thus Japan, by taking coal and iron from Manchuria is not thereby robbing China of an essential birthright.

It can be seen that Manchuria supplies certain essential requirements of Japan on the one hand and of China on the other. The aims of the two countries are not incompatible; indeed, the myth that the Japanese would settle Manchuria with enormous numbers of farmers is entirely now a matter of the past. The Japanese farmer hates the bitterly cold winter and the climatic conditions different from those he experiences in his own country. The Chinese farmer, on the other hand, is quite at home, for on the northern plains of China proper the winter temperatures are not far above zero and the land is ice-bound for the winter months. From the historical and ethnographical standpoint China has the stronger claim to the complete control of Manchuria, but from the point of view of the economic necessity Japan has a claim which is at least equally strong.

The obvious solution is the working together in peace and harmony of the two nations, both with their functions to perform in the country. But for Japan to give up her present rights and position without the absolute guarantee of safety and security for her supplies in the future would be to commit racial suicide.

Correspondence.

DRUMMING OF WOODPECKERS.

To the Editor of DISCOVERY.

DEAR SIR,

I read with interest Mr. Hendy's recent article on the drumming of woodpeckers. I had no idea that the nature of the tapping was not generally known. The woodpecker is a common bird here, and often of beautiful plumage—a dark blue bird, with red breast and high golden crest, is one of the most beautiful I have seen—hence it has interested me to watch the birds when possible, and, after repeated observations, I am sure Mr. Hendy is correct. It has always puzzled me, however, that any kind of pecking movement could be so rapid. A few days before reading the article I happened to come round a sharp turn on a soft path, and thus found myself only a few feet directly behind a tapping bird; it did not see me at once and continued to tap. As Mr. Hendy says, the movement is too rapid for the eye to follow, but from my position I could see that the head was swung from side to side, the beak apparently striking the wood as it passed. This easier movement accounts, I think, for the speed and lightness of the taps; it also explains the attitude of the bird's head, which I had noted before and which is held far back on the shoulders. I should be interested to know if other observers can support this suggestion. Possibly the birds are less shy here; indeed, the bird in question, when it saw me, ceased tapping but remained watching me till I moved away.

I have also seen the birds pecking, as Mr. Hendy describes, the bird digging savagely at the tree and dislodging big pieces of rotten wood. Obviously the drumming is quite a distinct process, though I do not know whether it is a call to other birds or whether it is connected with the locating of insects in the tree. I should expect that the bird's neck muscles must be very strongly developed to allow either movement. Possibly some more scientific observer than I could supply the information.

Yours, etc.,

Kota Pinang, Sumatra. G. C. FREDERIKSEN.

A STONEHENGE DISCOVERY

To the Editor of DISCOVERY.

DEAR SIR,

An interesting link with early Stonehenge is provided by the discovery of an eighteenth century guide book entitled "A Tour through the Whole Island of Great Britain by a Gentleman in 1757." The book contains a reference to a tablet of tin, found at Stonehenge in the reign of Henry VIII. The tablet bore a lengthy inscription, but in so strange a character that neither Sir Thomas Elliott, a learned antiquary of that day, nor Mr. Lilly, first High Master of St. Paul's School, could decipher it. It is possible that the tablet was a memorial of the founders, inscribed by the Druids, and it is much to be regretted that the tablet has not apparently been preserved.

Yours, etc.,

Amberley, Stroud. HUBERT BURROWS.

The Future of Dairy Research.

By Sir William Dampier, D.Sc., F.R.S.

In discussing the future of dairy research, Sir William Dampier points a warning. Progress in the theory of dairying will certainly reduce production costs, but unless the demand is stimulated as prices are lowered, over-production may still further be increased. The National Dairy Exhibition was held in London last month.*

DAIRY research may be described as the study by scientific methods of the dairy industry and its products, and of the fundamental scientific principles underlying its operations. Such a definition shows the wide scope of the subject. The dairy industry begins with the dairy farm, including the growth of fodder, both grass and arable crops, the breeding, management and feeding of the dairy herd, the production of milk, the operation of milking and the handling of milk, farm processes for the conversion of milk into dairy products such as butter or cheese, and the storage and marketing of milk and these products. Moreover, to obtain a complete survey, most of the problems need studying from many aspects—agricultural, chemical and physical, physiological, bacteriological, statistical, economic and financial.

Among recent researches into cattle food in the various countries of the world are many of interest to the dairy industry. First let us take into consideration work on the improvement of pastures. Grassland farming is of more importance in these islands than in almost any other place, and in consequence most of the work on grass is British. Modern investigation of pastures and pasture grasses began at the end of last century, and was followed by the well-known experiments on phosphatic manures and the later revelation of the importance of wild white clover. Work on the composition and improvement of pastures is now going on in many places.

A Notable Discovery.

One of the outstanding results is the discovery of the special nutritive value of young grass and other plants. It has been shown that grass cut at intervals of not more than three weeks contains large amounts of digestible proteins—so much, indeed, that for equal weights of dry material, its nutritive value approximates to that of concentrated food-stuffs like linseed cake. Frequent cutting or intense grazing diminishes the total yield of grass, and hence stimulation of its growth by nitrogen fertilizers is found necessary. The practical problems involved in this system of intensive manuring and grazing are being studied by many agriculturists.

The importance of a balanced supply of mineral constituents in pastures has recently been demonstrated. If the pasture is short of minerals, or if they are ill-balanced, the drain involved in giving milk may result in removing some essential component of a cow's body, and diminution in milk or actual disease may follow. It has been found that the poverty of some pastures is due to the want of one or more special ingredients, but with the knowledge at hand or likely soon to be available, it has been concluded that the productivity of the grazing lands of the world can be doubled.

New Types of Grass.

The utility of various indigenous and imported species of grasses and clovers, and the methods of breeding and selection necessary to produce pedigree strains, have been worked out in Wales. The importance of thorough and deep harrowing of permanent grassland has been demonstrated by accident and by other forms of practical experience, and by systematic experiments. Lucerne, owing to its high content of protein and minerals, is a valuable crop for a dairy farm. New varieties are being introduced and work on the inoculation of soil has enabled many farmers to grow lucerne where it failed before. Over 4,000 acres were sown with inoculated seed in 1930, and a much larger area in 1931.

Modern nutritional work is based on fundamental researches now many years old. The distinction between food needed for maintenance and that used in the production of meat or milk was first drawn in 1887; the "starch-equivalent" method of assessing nutritive values was developed in 1905, and later that of "net energy value," commonly used in America, and now based on new figures obtained a few years ago. Between 1906 and 1912, the necessity of "accessory food factors," now called "vitamins," was discovered, while requirements in mineral salts have more lately been studied. The problem of feeding is now known to be far more complicated than the early experimenters on energy values realized, and much of the knowledge acquired by practical farmers by slow experience has been justified and

*Extracts from a report to the Empire Marketing Board, reproduced by permission of the Controller, H.M. Stationery Office.

explained scientifically. It may fairly be claimed that this stage is now past, and that nutritional science, in its turn, can give information of use to the practical stock-owner, in making his methods of feeding both cheaper and more effective by a scientific system of rationing.

A survey of a hundred farms supplying milk to Aberdeen shows that valuable information about the conditions necessary for financial success in dairying can be obtained by the comparison of farms by the survey method. The average length of the milking life of cows has recently been examined and found to be about four years. If this period could be increased, costs of production would be lowered. The cost of production of "ordinary" farm milk has recently been studied: it was found that 60 per cent. of the cost was assignable to food and 20 per cent. to direct labour, the balance being represented by depreciation, distribution and sundries. For the years 1923-25, food cost from 8d. to 17d. a gallon, and labour 2.35d. to 6.47d. showing the wide divergence which exists between different farms. In reports describing five years' investigations, the conditions necessary for financial success are shown to depend not only on the yield per cow but on economy in feeding and labour, and on good management generally, both of the milking herd and of the young stock. The cost of rearing calves till they enter the dairy herd as heifers ranged from £21 to £42 per head—another indication of the wide differences in the skill of management.

It is important to compare the cost of "ordinary" milk with the best that is now obtainable. It is estimated that the additional cost of clean milk from tested herds free from tubercle, as compared with average farm milk, is about 3d. per gallon, including a slight margin for the farmer. The production of this milk should clearly be encouraged, both on the score of public health and because it is less likely to be faced with effective foreign competition. As the standard of quality of milk rises, foreign milk and milk products of unknown cleanliness might well be excluded altogether. Some practical farmers believe that the total yield of milk and the cost of milk production might be lowered by increasing the intervals between calving: this point might well be investigated.

The problems of genetics affect not only dairy farmers. Indeed, they are of fundamental scientific interest, and on the applied side have a bearing on human sociology as well as on the production of domestic animals. Nevertheless, where breeding concerns the yield of milk, it becomes a problem of direct concern to the dairy industry. Most dairy farmers breed from their higher yielding cows, and pedigree stock-owners in the past have enormously improved our flocks and herds. A mass of hitherto unco-ordinated information is possessed by practical farmers, yet the problem of the inheritance of high milking qualities is still far from reaching a complete solution. Indeed, with the most important of English breeds—the dairy shorthorn—the quality of calves when they enter the dairy herd seems still largely a matter of chance. Progressive farmers now generally feel that the only sure method of breeding is to watch the milk yields of a bull's daughters when they come into the herd, and only to continue to use bulls which are thus proved successful.

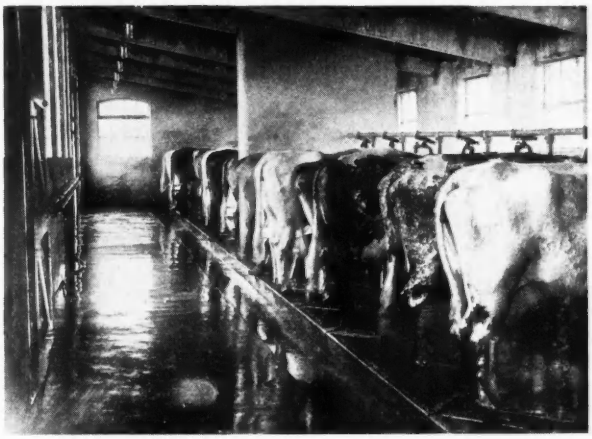
The diseases of dairy stock cause an immense loss every year, and some of them, especially tuberculosis, are dangerous to mankind. Recently a method of preventive inoculation for tubercle has been studied. Difficulties arise from the fact that beasts when inoculated react to the tuberculin test. Nevertheless, by using strong doses of vaccine and injecting them intravenously, effective protection from the disease seems to have been obtained, and from the work as a whole there seem good prospects of useful results. A tubercle-free herd has been built up from one originally infected; the calves were removed from their mothers at birth, and the precautions necessary for success in artificial feeding examined.

Johne's disease, which causes great monetary loss, has been investigated among others and a successful diagnostic has been produced. By its

CHEMICAL LABORATORY AT SHINFIELD.

Laboratory work plays an important part in modern dairy research. The photograph shows a corner of the chemical laboratory at the National Institute at Shinfield.

means infected calves can be detected, fattened for slaughter, and thus the herd protected with little cost. Some years ago foot-and-mouth disease was shown to be due to a filter-passing virus, and many of the difficulties in dealing with it are thus explained. The virus cannot yet be grown freely outside a living animal, but the discovery of the possibility of its transmission to guinea pigs makes investigation considerably easier. Work is being done on the length of time the virus remains active within and without the body, on immunity and on inoculation.



A MODERN MILKING SHED.

The average length of the milking life of cows has recently been found to be about four years. If this period could be increased, costs of production would be lowered.

Recent research has shown that pasteurizing causes physical and chemical changes in milk, which make calves fed on pasteurized milk to thrive less well than those fed on raw milk. Less calcium, phosphorus and nitrogen are absorbed when heated milk is used, the calcium being rendered less soluble. Experiments on rats are being carried out at the National Institute for Research in Dairying at Shinfield. Rats fed on sterilized milk—that is milk heated for some time to 100° C.—make little growth, soon age and cease to breed. With pasteurized milk, while the does do well, the bucks make much slower progress. This experiment is in its early stages, but promises interesting results.

Little, if anything, has been done to examine the special nutritive value for children of dried and condensed milk as compared with raw milk, and experiments on this point are urgently needed. Also it is possible that the experiments which used pasteurized milk as human food were not delicate enough to test the differences between it and raw milk, and further investigation is desirable. Some hold that, for the present, unless milk is clean and free from infection, it had better be pasteurized, while others fear that a general adoption of pasteurization would set back the movement for clean and tubercle-free milk. Cream from ordinary commercial milk must, it seems, be pasteurized to make its distribution possible without preservatives. But, whatever be the truth about these questions, all efforts should be made to develop the movement for clean milk.

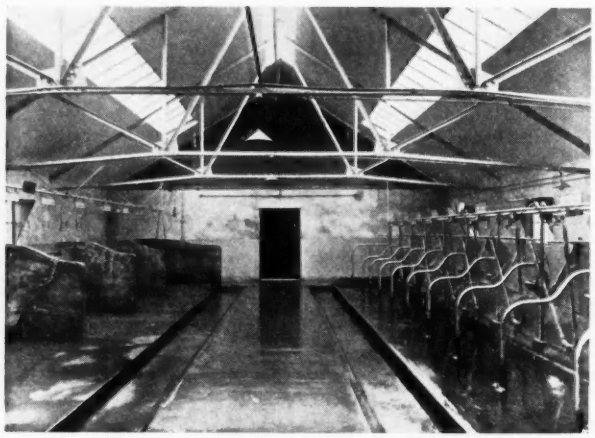
The bacteriology of milk has for many years produced an enormous volume of literature; indeed the favourable medium for bacterial growth which milk offers, and the importance of tracing and preventing the many possible sources of infection by milk-borne diseases, have directed perhaps more attention to this aspect of dairy research than to any other.

The classification of milk according to its bacteriological contents involves an estimation of the quality of milk either for consumption as liquid or for use in the manufacture of butter or cheese. The methods appropriate to these two problems may be different. In England, the establishment of high-grade and certified milk requires very great purity, and nothing but actual bacterial "counts" are delicate enough as tests to classify the milk. But, in the north of Europe, where standards are at present not so high and much of the milk goes in the manufacture of dairy products, general use is made of the "reductase" test, which takes the time required to decolourize a definite solution of methylene blue as a measure of the purity of the milk, and enables analysts with little trouble to classify milk in four grades. Combined with the fermentation test it shows whether milk is suitable for cheese-making.

The problems which underlie the manufacture of primary dairy products, especially butter and cheese, are being examined in this country and in New Zealand. The trouble in cheese known as "open-ness" is being investigated and red spot in cheese and oiliness in butter have been studied with some success. Red spot has been shown to be due to a form of infection, and oiliness to the action of metallic catalysts in suitable environment. The specific enquiries on these faults have led to more general work on the ripening of cheese and the quality and preservation of butter, which must be regarded as the fundamental problem of those, the most important, dairy products. These investigations will probably for long form part of the staple work at one or more dairy institutes.

An increasing amount of milk is being condensed and dried. In the United States in 1926 more than

91 million pounds of dried skim milk and more than 10 million pounds of dried whole milk were produced. Milk is also dried in large quantities in Australia, New Zealand, Canada and Holland. The qualities depend on the method of manufacture in ways not yet fully worked out, and the uses include not only the reconstitution of milk, but the improvement of bread, etc. The residue from cheese-vats, whey, is used on farms for pig-feeding. Cheese factories usually have large volumes of surplus whey during the summer: much more at times than they can use or sell as pig-food. The difficulties which arose in disposing of this surplus during and just after the war led to an investigation of the manufacture of lactose as a method of using superfluous whey. The result was the establishment in England and New Zealand of factories which produce lactose and residues made into feeding stuffs. Here the many problems which arise in the utilization of whey are investigated.



SCOTTISH DAIRY BYRE.

Apparatus is constantly being improved. The photograph shows the dairy byre at the Hannah Institute, Ayr, with the different types of fitting which are being tested.

The most important recent work on dairy machinery consists of investigations on milking machines. Tests take months to complete, since, to examine the effects on the cow, it is necessary to carry on the work through a complete lactation. Many of the difficulties found with milking machines are due to inadequate cleansing, and the only way to get satisfactory results with certainty is to sterilize the apparatus with steam.

It remains to examine the relative advantages of hand and machine milking. In Scotland it was found that when wages are high a milking machine is worth installing with a forty cow herd, but when wages are low it is not likely to pay unless at least sixty cows are milked.

In considering the future of dairy research, two important cautions are necessary. It is, of course, possible to state what seem to an observer at any given moment the directions in which research is most likely to obtain important results in the immediate future. But it is probable, indeed almost certain, that over any considerable time such a prophecy will prove to have been wrong. The path which research opens into the unknown cannot be traced far ahead. At any point a new and unforeseen prospect may open out and a sharp turn in direction become necessary. I can say what seems to me to be the most promising lines of enquiry at this moment but my opinion would, I hope, be quite different after the lapse of time. It is essential to keep an open mind and to be ready at any moment to revise one's opinions.

The second caution I wish to make is this: Our rapidly growing knowledge of the underlying sciences, and of the practical methods best adapted to secure their application to dairying, should have a beneficial effect on the milk industry. It will certainly increase the yield of milk and diminish the costs of production, but its influence on profits involves elements of doubt. It will increase profits only if demand grows at least as fast as supply, and a growing demand will depend on an improvement in marketing and in the organization of propaganda. Unless demand can be stimulated as prices are lowered, the effect of improvement in the theory and practice of dairying may be to increase the over-production from which the industry is already suffering at present prices.

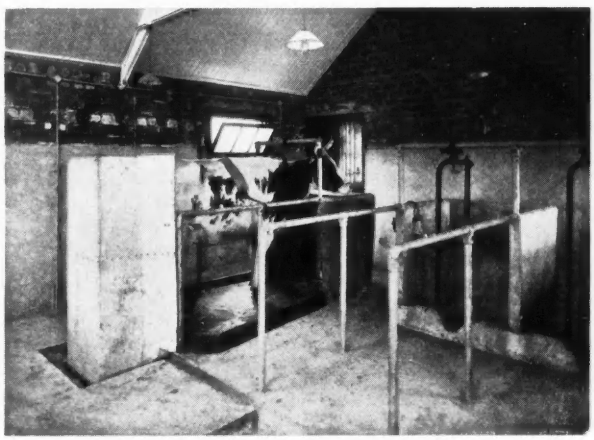
Research on the selection, genetics and growth of different species and strains of fodder crops, especially of grasses and clovers, seems to me of fundamental importance and worthy of all necessary financial support. The work is not being done at dairy institutes, but is none the less important for dairying. The same remarks apply to the work going on upon the treatment of grass-land to get the best results of frequent cutting and intensive grazing.

Other questions important from the practical point of view which in my opinion need further enquiry are: the effect of farm-yard manure on the fertility of pastures; the differences between the milk of pasture-fed and of stall-fed cows, for instance in its content of vitamins, and especially in its quality for manufacturing cheese and butter; the mineral

composition of the soil and the herbage of dairy pastures, and its effects on the manufacturing qualities of milk.

The information which has accumulated lately on the beneficial effect of vigorous harrowing on grass-land should be followed up. Further and more carefully planned scientific experiments on this point are desirable, and efforts should be made to bring the facts already known to the attention of grassland farmers.

The depression in arable farming has led to the conversion of large areas of plough-land into meadow and pasture. Where the process has been well done, and the climate and soil are favourable to grass, no regrets need be felt. It is probably the best way of meeting the depression in cereal prices. But much East Anglian land will not carry good permanent grass, fields are often large and unfenced, and water is sometimes not procurable. Hence the process of converting arable to grass-land has limits. Moreover, the sowing or "tumbling" down of ploughland to inferior grass, and its indiscriminate use for dairying, are calculated to depress the milk industry without giving much financial return to the farmer. Hence I think it important from the point of view of dairying to encourage any promising alternative method, whereby cultivation can be cheapened and arable land kept under the plough. Mr. C. S. Orwin has emphasized the success which has attended some of those who, leaving the familiar rotations, have specialized in corn-growing. Perhaps he has not adequately described the achievements of skilful farmers who, in the same hard times, have made older methods pay. But certainly further experiments in this and other directions are desirable. Again, some progressive farmers are alternating four years of corn-growing with four years of temporary grass leys, on which bullocks and grass-land sheep are fed. This method of alternation is used in Scotland. Scientific investigation of its adaptability to English conditions is beginning at the Cambridge School of Agriculture, and should, I think, be extended in scale there or elsewhere, first as an experiment, and then, if successful, as a demonstration. Directly, this is an attempt to meet the agricultural and economic problem of the remunerative use of East Anglian land, but indirectly, as preventing an ill-advised increase in milk-production, it may be of very great use to the dairying industry.



MEASURING FOOD REQUIREMENTS.

An interior view of the special metabolism house at the Hannah Research Institute, in which the scientific food requirements of dairy cattle can be accurately measured.

Further information is needed before these possible new methods are extensively adopted by arable farmers. They are not proposed as a solution of the present difficult problems due to the crisis in corn-growing. But if the new methods prove a success other problems will arise. The change from present methods of arable cultivation will involve considerable expenditure for fencing, water supply and grass seeds. If the depression still continues, and it is thought right to help arable farmers over a time of transition at the expense of public funds, a grant in aid of this necessary capital expenditure would be free from some of the objections which have been urged against certain other forms of subsidy.

In spite of the general opinion of "practical men" that the food of cows influences the percentage of fat in milk, properly controlled experiments show that ordinary variations in food cause very little effect. Even diminishing the food till it verges on a starvation ration, while it decreases the quantity, is stated hardly to affect the fat contents of milk. It has been shown that one kind of food—young grass—is specially efficacious in increasing the yield of milk, so that the change in food is responsible for some or all of the flush of milk in spring. This high yield can be maintained by dried young grass. Young grass is now, or soon will be, available in large quantities in the form of ensilage and of dried cake, and more experiments on its influence on the quantity and quality of milk should be made. All research institutes should be encouraged to investigate the fundamental problems of pure science as well as the practical problems which arise. Indeed, practical advance may soon stop if pure research is starved.

A Footnote to the French Revolution.

By Muriel Kent.

A pamphlet containing an intimate account of the judgment of Louis XVI has recently come to light. Its author was an emigrant in England and his first-hand account forms an interesting footnote to the official records.

THE old pamphlet compiled by "a French clergyman, emigrant in England," contains an outline of certain crucial events in the French Revolution, and is entitled "Judgment and Execution of Louis XVI, King of France; with a list of the members of the National Convention who voted for or against his Death, etc." This record was dedicated to the benevolent people, numbering nine hundred, who subscribed for its publication in order to help "the afflicted stranger" in their midst. Though the title-page of this second edition is undated, the pamphlet was evidently printed soon after the close of the Reign of Terror.

The King's Trial.

On 15th January, 1793, the form of the three questions to be proposed to the Convention was decided, in this order: Is Louis guilty or not? Shall the sentence to be passed upon Louis be referred to the sanction of the people? What punishment shall be inflicted upon Louis? By overwhelming majorities the King was pronounced guilty, and the question of appeal to the people negatived. From Wednesday, 16th January, to Sunday morning, with little interval, the Deputies were gathered in that Hall of Doom, as Carlyle calls it; first to debate the Girondins' proposal that a majority of three-fourths should be required to decide the Third Question; then, after Danton had thrown the weight of his influence against this proposal, they began the Third Voting at eight o'clock on Wednesday evening.

If Goudemetz fled to England only after the King's execution, his main information would be drawn from the official records of the time. Carlyle's later version, based on the Assembly reports, is interpolated with his judicial comments or vehement rhetoric; and with impressions of the actors in that scene: "shrill Sieyes," hardly pausing at the Tribune as he says, "La Mort sans phrase": Philippe Egalité voting on his conscience for death: Duchâtel, ill and wrapped in blankets, carried in to vote for mercy at the last moment. Carlyle shows, too, the background of all these movements and decisions—not of a solemn, or even grave character, but filled with curious onlookers, ushers passing to and fro, summoning deputies to vote—rousing some from sleep—or opening galleries for privileged visitors: women "rustling with laces and tricolour," keeping the score of ayes and noes, as at a game of *Rouge et Noir*, or chatting with their friends among the members who entertain them, while in the upper galleries, there is "drinking of wine and brandy as in open tavern."

Goudemetz's tabulated record of the Judgment is impressive in a very different way. Here, under their departments, are the names of all the deputies, with distinguishing marks to show those who voted absolutely for death; those who added some condition of delay; and the large number of those who voted for confinement or banishment. Carlyle scarcely does justice to the men who, in the face of excited and menacing "patriotism," protested during the third voting against a condemnation which they, partially at least, recognized as a folly that must ultimately affect the destiny of the Republic.

Goudemetz, however, quotes the actual words used by these deputies; of Alasseur (Le Cher), "What says history? Caesar was assassinated, and had a successor. The English sacrificed their tyrant, and returned to their chains. Rome banished her kings, and had liberty. I am for banishment." Many refused to pass sentence on Louis on the ground that they had no authority to do so; Perès, of Haute Garonne, declared: "We are a political body, and not a court of justice; we cannot make ourselves judges without becoming despots. I vote for confinement and afterwards banishment." Marcy, of Cote d'Or, took a longer view: "You are the depositaries of French honour. Europe has her eyes upon you. Posterity is advancing. It will judge you, and its voice will pass through ages."

An Advocate's Appeal.

The emigrant clergyman quotes both the "sentence of rigour" passed by President Vergniault and the King's appeal to the nation, met by the Convention with immediate refusal. Here, too, are the words of Desèze, one of the King's three advocates, in support of that ratification by the French people which Louis demanded. He pointed out that this was only "the exercise of a natural and sacred right which belongs to every person accused"; he claimed this right for Louis "in the name of justice, in the name of our country, in the name of humanity." He pleaded the significance of the narrow majority of votes for death unconditionally—giving the number

as five. The authorities vary somewhat in their reckoning, some affirming that the "absolute majority" was reached by only one vote.

At the third voting the extremists successfully resisted a final attempt to defer the King's execution; and late in the afternoon of Sunday, 20th January, the warrant was conveyed to the Temple, and received by Louis. His request for three days' respite, with certain alleviations in the interval, was refused; the only concessions made to him in his last hours were that he was granted an interview with his family, without witnesses, and that the confessor whose assistance he desired in preparing for death was allowed to render "this charitable office," and attend him to the scaffold next day.

Goudemetz gives only a brief account of the final scenes, described in detail by the Abbé Edgeworth, whose narrative has been recently reprinted in "The Black Book of Edgeworthstown." No one but the devoted priest and friend of the royal prisoners could describe those scenes so vividly, recalling his own memories of the execution morning, of his drive with the King, in Pethion's coach with two gendarmes, through the Boulevards, lined with soldiers, while the King sat absorbed in reading the prayers for the dying. Carlyle presents Louis XVI as a piteous figure, brought to his end by his own incapacity, and adverse circumstances. The Abbé shows a man who, if ill-fitted to be King of France at a time of national crisis, could die like a saint—declaring, indeed, his innocence of the crimes laid to his charge, but pardoning his accusers.

In the long list of deputies, more than fifty have the letter "G." opposite their names, showing that they, too, were guillotined before the close of the Revolution. Goudemetz also mentions those who were imprisoned or proscribed, and a few who perished by assassination, suicide, or in massacres. There is one man whose name appears only among those who voted for death in the third *appel nominal*. It was Barère, whom Carlyle described as "incomparable in the art of varnish." Carlyle devoted one of his Miscellaneous Papers to exposing Barère's falsified history of the sinking of the *Vengeur* in the Battle of the First of June, 1794. It was for this paper that Carlyle was violently attacked by the French Press in 1839-40. Although Barère has never occupied the stage so conspicuously as other revolutionary leaders, such as Marat and Robespierre, it was he who was more responsible than anyone else for the intensified savagery of the last months.

Burke's name for him, "the Anacreon of the guillotine," was adopted by Carlyle as a just and convenient epitome of Barère's qualities. His convictions were certainly less conspicuous than his instinct for placing himself on the winning side; like Napoleon Bonaparte, he recognized that "the beginning of a revolution is a fine time for an enterprising young man." As a country lawyer he had acquired a highly persuasive manner, and his speech from the Centre on 3rd January determined the course of the King's trial. Barère's principles were, in fact, so elastic that, having adroitly survived the Revolution, he first served Napoleon as a spy, and later proffered his services both to Louis XVIII and to Louis-Philippe.

Goudemetz concluded his Memorial with a list of "many of the most considerable sufferers under the French Revolution"; a list which covers some twenty pages, even though large groups of prisoners are entered collectively. Loyalists and republicans, nobles and leaders of the people, men and women, old and young, are all represented in this curious pamphlet.

JUDGMENT
AND
EXECUTION
OF
LOUIS XVI.
KING OF FRANCE;
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MEMBERS OF THE NATIONAL CONVENTION,
Who voted for and againſt his DEATH;
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MANY OF THE MOST CONSIDERABLE SUFFERERS
In the Courſe of the FRENCH REVOLUTION,
Diſtinguiſhed according to their PRINCIPLES.

THE SECOND EDITION.

By H. GOUDEMETZ,
A French Clergyman, emigrant in England.

THE TITLE PAGE OF THE PAMPHLET.

The Shape of the Earth.

The problem of the exact shape of the earth, upon which pioneering work was done by Columbus and Magellan over four centuries ago, will be attacked by an international expedition which is sailing this month for the West Indies.

In the waters about the West Indian islands, with the assistance of the submarine S-48 lent by the United States Navy, an expedition is to make a concentrated study of geological conditions. It is being sponsored by Princeton University and has the support of the Royal Society of Great Britain. Other scientific bodies in England and America are also co-operating, including the National Research Council, the United States Hydrographic Office, the Naval Observatory, and the Coast and Geodetic Survey.

Geological Problems.

"The West Indian region is an ideal place in which to attack some of the major geological problems," writes Professor Richard Field, director of the expedition. "We wish to know not only what has gone on in the past in the Bahama region, but also what is going on there now. If we can discover the causes for the uplift of these islands and their maintenance, as well as the mile-deep depressions which exist between them (as exemplified by the great Bartlett trough south of Cuba, and the Nares deep north of Porto Rico) we would unquestionably learn something further regarding the origin and periodicity of the earthquakes in this region, and possibly also in the south-easterly islands of the archipelago.

"Due to permission given by the British Government and to the co-operation of the United States Navy, this expedition will be able to determine the exact topography of the floor of the ocean throughout the field of operation. The recent perfection by the United States Navy of the means of making directional echo soundings permits us for the first time accurately to determine the inequalities of the bottom of the ocean. The use of a submarine will make it possible to experiment with the delicate Meinesz clock in a relatively steady environment from 60 to 80 feet below the surface of the sea."

This clock, known as the three pendulum apparatus, has been invented by Dr. F. A. Vening Meinesz, a member of the Geodetic Commission of Holland. It has a special arrangement of pendulums swinging simultaneously in such a manner that when one pendulum of a pair is retarded by external forces the other is accelerated by an equal amount; in effect, therefore, the combined oscillations of these two pendulums is a record of an undisturbed theoretical pendulum. The rates of the swing of the pendulums, which are of primary importance in ascertaining gravity, will be determined by chronometers on board the submarine and at the stations to be established on the islands. These in turn will be regulated by wireless time signals sent from the Naval Observatory in Washington.

To supplement the work done on the submarine over the water areas, an observer of the American Geodetic Survey will also make gravity observations during the winter on 15 or 20 islands in the Bahama group. "These observations," Dr. Field explained, "furnish an indirect method of finding the difference in weight between imaginary segments of the earth's crust, which extends to a depth of approximately 60 miles below sea level. Except where ocean bottoms are very much broken, the values of gravity are practically normal. Where the ground is broken, outstanding irregularities are found in the values of gravity.

"If these irregularities are discovered in the Bahama regions they will indicate either that there is an excess or deficiency of mass in the segments of the crust under the islands, or that the rocks beneath the crust are abnormal in density. If volcanic rocks of greater density than normal surface rocks are close to the surface under the Bahamas, the values of gravity should be in excess. If, on the other hand, these islands are not volcanic in character, gravity values should be normal or nearly so."

The submarine S-48 will be accompanied by the mine-sweeper *Chewink*, and the expedition will also make use of a third vessel owned and navigated by Hugh Matheson, of Miami, Florida. The personnel of the advisory staff includes Professor E. B. Bailey, of the University of Glasgow, Professor Owen Thomas Jones of Cambridge, and Mr. Maurice Black, who contributed an article to *Discovery* in March, 1930, on the results of a preliminary survey of the Bahamas.

A New Biological Station.

A biological station, to which the Rockefeller Foundation has made a grant of £50,000, has just been opened in Bermuda by the governor, Sir Thomas Cubitt, on land presented by the Government. Dr. Wheeler of Plymouth has been appointed director of the station and will be assisted by a committee of scientists from various countries. A great future for the work was predicted by Professor E. C. Conklin of Princeton, who said that the station would attract scientists from all over the world.

Book Reviews.

What Dare I Think? By JULIAN HUXLEY. (Chatto & Windus. 7s. 6d.).

Reviewed by THE VERY REV. THE DEAN OF EXETER.

In this attractive volume Professor Huxley has brought together some lectures and essays on such varied subjects as Biology and the Physical Environment of Man and Science and the Future of Religion. There is, however, a certain unity of purpose in the book, since the essays are all, directly or indirectly, expositions of what the author calls Scientific Humanism. The word "Humanism" is getting sadly overworked and seems to apply to some greatly divergent positions. Thus Professor Huxley's Humanism has very little in common with that of Professor Babbitt and other American authors. The essential idea in scientific Humanism appears to be that of the utilization of the power over nature which science gives for the "relief of man's estate" and perhaps also for the "enhancement of human dignity." The phrases quoted in the last sentence remind me that this ideal is by no means new. The author is in the respectable company of Francis Bacon.

By far the most interesting things in this book are the discussions of the possible control of human nature and character through the discoveries of biology and psychology. The author does no more than sketch the vistas which are opened, but probably nothing more could be expected in a popular work. It is to be hoped that many thoughtful people will be stimulated to reflect upon the problems which lie beneath our modern civilization. On one of these problems Professor Huxley takes a definitely gloomy view. He thinks that the tendency of our present social organization is to ensure that the earth should be inherited not only by the meek but by the "stupid, the shiftless, the imprudent, and the dull." There is, unfortunately, only too much ground for believing that biological causes are, in fact, making towards this result. Too often the remedies proposed by eugenists and others are only practicable in a completely transformed society. The author has the great merit of suggesting the next step, one which could be taken without delay if politicians were sufficiently enlightened.

Concerning the author's view on religion it is not possible to write with such admiration or assurance. He repeats again his twofold conviction that humanity cannot get on without religion and that it is not possible for an intelligent man to believe in God. He has not considered the remarkable developments of scientific cosmology in relation to the problem of Reality, which is surely surprising in a lecture on Religion and Science. The following reference to the work of Bergson, Driesch, Whitehead and Eddington is startling: "The net result of the thesis maintained by such writers is something like this: the scientific account of things ends in obscurity and irrationality; let us accordingly introduce a corresponding dose of unintelligibility on the philosophic and religious side, and then the accounts will balance." The mixture of metaphors here is surely the sign of hasty writing; and only haste could excuse so ridiculous a travesty of Whitehead's thought.

Professor Huxley, in truth, is not really at home in the realm of philosophy and has a habit of speaking magisterially on questions of metaphysics and theology which is apt to infuriate those who have given as much attention to those subjects as he has given to biology. One curious sign of his philosophical incoherence is his treatment of "values." Unlike Earl Russell, he holds that of values we are "certain" and that they have an absolute right to our allegiance. But he seems never to have asked the question whether this certainty about values does not throw some light upon the nature of Reality.

We are exhorted to a "reverent agnosticism about ultimates." Why "reverent"? What is the point of being reverent with respect to something I know nothing whatever about? Religion without worship of a God who is both the Supreme Reality and the Supreme Value will become either a superstition or a farce.

Invention and the Unconscious. By JOSEPH MARIE MONTMASSON. Translated with a Preface by H. STAFFORD HATFIELD. (Kegan Paul. 25s.).

"A fact has struck me: the first idea of a large number of inventions was not the logical outcome of long trains of reasoning; it was revealed suddenly to the mind of the seeker, after a long unconscious incubation." Thus M. Montmasson begins his informing and stimulating essay, in which he first examines many discoveries or inventions in the scientific and mechanical field and then considers generally how the unconscious mind may bring inventions to birth. The series of examples, when carefully studied, shows that there was always some gap in the purely logical study of a problem, and that this gap was triumphantly surmounted by what may be called a guess or an intuition but is better explained as the unconscious mind working on the facts presented to it by the conscious. Such inventors as Watt, Stephenson, Daguerre, and such great scientists as Ampère and Pasteur are cited, with many others, in this connection. Each one of them had first to know what he wanted to do. The problem before him was definite and exercised his active intelligence. The unconscious did the rest for him, because he was a genius. Why he had this special quality in his unconscious mind remains a mystery. If we could solve it, we might, as the translator suggests in a thoughtful introduction, train our children—if we began with them young enough—to be inventive geniuses too. At any rate, M. Montmasson's line of inquiry offers fascinating possibilities. Incidentally, Sir Oliver Lodge in his autobiography has supplied further confirmation of M. Montmasson's theory. "When I was getting near to any result in physics," he says, "I became afflicted with a kind of excitement which caused me to pause and not pursue that path to the luminous end." And again—"Whenever I read modern physics I acquire a sort of vision and perceive in a short time a sort of vista of unexplored territory. But it seems too exciting to be pursued straightway." Here Sir Oliver's unconscious mind appears to have put a brake, as it were, on conscious intelligence, and acted as a hindrance rather than a stimulus.

Mr. Hatfield raises a still larger question. "Human invention," he says, "is the psychical counterpart of the modifications of structure, instinct and habit by which living species have been produced." The origin of species has been discussed for generations, but mainly from other points of view. Is it possible that, like the human inventor, some individual of a species has suddenly modified its habits to meet some emergency and set the fashion, so to say, for its fellows, thus bringing a new species gradually into existence? Normally the human race goes on using traditional tools and methods. Normally a species confronted by changed conditions dies out. The inventor and the new species are departures from the normal. Is there more than an analogy in the two cases? The question can only be stated here in the baldest terms. But enough has been said to show the extreme interest of M. Montmasson's book, the latest addition to the great "International Library of Psychology, Philosophy and Scientific Method."

Faraday and his Metallurgical Researches. With Special Reference to their Bearing on the Development of Alloy Steels. By SIR ROBERT HADFIELD, Bart. (Chapman & Hall. 21*s*.).

As the discoverer of manganese steel and the active promoter of other important developments in steel-making, Sir Robert Hadfield is specially qualified to assess the value of Faraday's early metallurgical researches. In his new book, Sir Robert demonstrates with his accustomed thoroughness that the work done on alloy steels by Faraday between 1819 and 1824—that is, between the ages of twenty-eight and thirty-three—was " of real interest and value " and half a century in advance of the needs of his time. Most of us think of Faraday primarily as a physicist, since he divined the principle of the electric motor in 1821 and discovered induction in 1831. But he was in his earlier years specially interested in chemistry ; he obtained his post at the Royal Institution as a chemist, and he was elected to the Royal Society on the strength of his chemical papers. It is good to know, on such high authority as Sir Robert Hadfield's, that Faraday's experiments with alloy steels—alloyed mainly with the precious metals and in no case with manganese—were, in point of novelty and significance, not inferior to his physical work. A Sheffield firm was interested in his alloys, but nothing came of them at the time, partly because of practical difficulties in manufacture but mainly, no doubt, because Faraday passed on to other problems.

The book gives an account of Faraday's early life, describes the Royal Institution of a century ago and the leading scientists then connected with it—notably James Stodart, F.R.S., the surgical instrument maker, who collaborated with Faraday—and recalls the earlier workers in metallurgy who, like Faraday, were specially interested in " wootz " or Indian steel. A full summary of Faraday's papers on steel alloys is given, and the reader is shown how slight and imperfect were the facilities then available for such difficult research. Next we have a most elaborate and exhaustive examination of the specimens left by Faraday, on which the author has expended infinite labour. Finally, Sir Robert sketches the modern developments of alloy steels, which have revolutionized the whole industry and are still very far from completion, especially now that the induction furnace is being enlarged and improved. The book is finely printed and richly illustrated, and forms not merely a glowing tribute to Faraday, but also a most readable introduction to this vital branch of metallurgy. One trifling misprint may be noted for the next edition ; Edward Turner was the Professor of Chemistry at University College—not " Union College "—London, in 1832.

Nature by Night. By ARTHUR R. THOMPSON. (Ivor Nicholson & Watson. 12*s*. 6*d*.).

In his preface the author says " to be able to interpret the signs and sounds of the open wild country is a proud accomplishment." The truth of this every field naturalist knows, but where that knowledge includes the night as well as the day the achievement is even finer.

The book is extraordinarily comprehensive ; it begins with badgers, foxes and otters, passes on easily to stoats and weasels, rodents, large and small, hares, rabbits and squirrels, and so through insectivorous mammals to owls and other birds of the night, reptiles and amphibians, till, after a few remarks on moths, beetles and other " small deer," it ends with slugs ; but this is by no means a " lame and impotent conclusion." The whole is embellished and illuminated by really excellent photographs : those of the badger are perhaps the most impressive because, as we know from experience, this animal is the shyest and most difficult to observe of all our British mammals. The author gives some very useful hints on watching badgers : you must possess or acquire (*inter alia*) infinite patience, immobility when bitten by gnats, power to abstain from tobacco and an acute comprehension of weather signs and seasons and their effe upon your quarry. Badgers, as Mr. Thompson says, are rea plentiful, but so shy and secretive are they that only badger diggers and those who know nature by night ever see them.

As the author points out, the survival of the fox in cultivated country is due entirely to hunting : he thinks that the otter is rarer than the fox or badger and that it would be even le common but for hunting. In the same way, everyone w local knowledge agrees that the red deer on Exmoor owe th existence to stag-hunting. Mr. Thompson thinks that it woul be better if the otter—and all our wild life—could be preserved for its own sake ; but this is a counsel of perfection.

The author favours the theory that the white scut of a rabbit acts as a danger signal to the community though it may mean death to the individual rabbit, which, when unobserved, carries the tail downwards. With nature it is the species, not the individual, that matters. He states that he has seen pipistrelle bats drink in flight ; they certainly are not afraid of water ; we have seen one pitch in a small stream and float down it for several feet. We also have been struck by the robin's chilly habit of bathing just before it goes to roost ; lately we have noticed a common wren adopting a similarly Spartan habit.

It is significant that so careful an observer as the author condemns the grey squirrel. It bullies the red squirrel and has a bad record as to egg-stealing and the destruction of young trees. " If," he says, " the grey squirrel is not . . . greatly reduced in numbers (preferably exterminated) the red squirrel will probably disappear from our oak and beech woods. It may linger on in coniferous woods," which the grey does not seem to like.

Every field-naturalist and nature lover should read and acquire this book. He will find it invaluable not only as a record of the habits of those who walk, fly, or crawl by night, but as guide to the improvement of his own observations.

A History of Geographical Discovery and Exploration. By J. N. L. BAKER. (Harrap. 12*s*. 6*d*.).

The author essayed a tremendous task when he set out to write a history of geographical discovery through the ages. So many men, at different times and with different motives, have helped, bit by bit, to map the unknown world that the literature of the subject is colossal. Yet it may be said at once, and with complete assurance, that Mr. Baker has achieved his purpose with quite astonishing success. In some five hundred pages of rather small type, with a wonderful index of fifty pages, he gives a coherent, readable and detailed account of this fascinating sphere of human activity. He begins with the ancients, and Marco Polo and the Arabs, describes compactly the voyages of Columbus and his contemporaries, and then plunges into the main stream of modern exploration. His plan is convenient. Up to 1800 he deals with each continent in turn, treating separately of the Pacific and the mysterious " Terra Australis." Later he considers the work of the nineteenth century, continent by continent, with oceanic and Polar research

at the end. Anyone who has worked at any one small part of the field will realize the author's difficulties and appreciate his skill and labour. He brings pleasant relief to the narrative by making numerous quotations from the original stories of famous explorers, including, of course, Doughty in Arabia. And he is so far up to date as to mention Mr. Bertram Thomas's crossing of the South Arabian desert early this year.

The text is illustrated with a remarkable and most useful series of fifty sketch maps, showing the progress of discovery in the various continents in successive epochs. And the innumerable references to literature will enable the reader to expand for himself this necessarily brief account of work in any region. The book will at once become a standard work, indispensable to the student and of endless interest to all who delight in discovery and adventure. Mr. Baker and his publishers are very much to be congratulated.

The Sorcerers of Dobu. By R. F. FORTUNE. (Routledge. 15*s*.).

Dr. Fortune's description of life and society among the Dobu Islanders of the Western Pacific will take a high place among the accounts of more primitive peoples which have appeared in recent years. As his title suggests, magical beliefs and practices are greatly in evidence. But the more significant, and indeed the more valuable of the author's contributions to our knowledge of Melanesian custom lie in the analysis of the part played by the system of relationship and descent in determining the attitude and behaviour of individuals and groups one to another in the conduct of life both on normal and abnormal occasions. The social factor which dominates the life of the Dobuans is the strict local grouping of those who are related in the female line of descent. Only those so related are members of the village group, and although a husband lives in his wife's village for a period—family groups residing now in the husband's, now in the wife's village alternately—yet while there he is regarded as a stranger and suffers numerous disabilities in consequence, especially as the villagers regard all members of other villages as sorcerers and witches.

The strictness with which descent in the female line is observed has some remarkable results. Inheritance devolves on the children of a man's sister; and in theory he may not transmit even a knowledge of his own special magic to his son. In practice, however, family affection is sufficiently strong to bring it about that he does transgress this regulation; but it is done covertly. As Dr. Fortune shows, in many departments of life family ties pull with more or less success against the claims of the matrilineal kin. It is evident here, and in regard to marriage, as well as other details of life that obedience to social regulation is by no means automatic and invariable, even though the consequences are patent in the persons of the Ishmaels who have transgressed.

In these few lines it has been possible hardly even to suggest the character of the material which Dr. Fortune has worked up with such great skill into a coherent account of how a society organized on these lines actually functions. His work is equally thorough and his data equally striking in other departments of life—such, for example, as the garden, the centre of the economic and ritual life of the Dobuans, and magic, with the differentiated functions and technique of the men and women magicians, as well as the specialized magic owned by each group, also transmitted in the female line. In many points their sexual life is of particular interest. They are remarkable, for example, among people in their grade of culture in exhibiting an extreme prudery in word and in the superficialities of behaviour, while in their more intimate conduct they are morally lax, not merely on our standards, but according to their own. Professor Malinowski contributes an introduction in which he compares Dr. Fortune's results with those obtained by himself among the neighbouring Trobriand Islanders. He praises Dr. Fortune's work in terms which are no exaggeration.

James Clerk Maxwell. A Commemoration Volume. 1831-1931. (Cambridge University Press. 6*s*.).

Clerk Maxwell died in 1879, when he was only forty-eight, but after half a century his reputation as a physicist is world-wide and unshaken. It was a happy idea on the part of his Cambridge disciples to produce this commemorative volume, small in compass but very impressive in content because all the contributors are distinguished. Sir J. J. Thomson gives a brief memoir of this extraordinary Scotsman who, when he went up to Trinity, Cambridge, seemed to his friend Butler, the future Master, to be "the one acknowledged man of genius among the undergraduates," and who astonished the tutors in no less degree. Dr. Max Planck describes Maxwell's influence on theoretical physics in Germany, and Dr. Einstein defines his influence on the development of the conception of physical reality. Sir Joseph Larmer, Sir James Jeans and Sir Oliver Lodge discuss respectively his environment, his method, and the bearing of his researches on the initial stages of wireless telegraphy. Four of Clerk Maxwell's old students—Mr. William Garnett, Sir Ambrose Fleming, Sir R. T. Glazebrook and Sir Horace Lamb—give some delightful reminiscences of the great man under whom they worked in the Cavendish Laboratory at Cambridge between 1871 and 1879. Those who know the ways of the older universities will not be surprised to learn that Clerk Maxwell as Professor at the very height of his fame had an audience of only two persons. Sir Ambrose Fleming, who was one of them, says that he took full notes which are to be preserved in the Cavendish Laboratory. The little book, illustrated with two portraits, is well worth reading.

Johann Kepler: 1571—1630. A Tercentenary Commemoration. (Baillière, Tindall & Cox. 13*s*. 6*d*.).

The work of Kepler, the German astronomer, who developed and improved on the theories of Copernicus and Tycho Brahe and paved the way for Newton, is well described by several American scientists in this compact volume prepared for the History of Science Society. Kepler dominated the transitional period between what we regard as the unscientific Middle Ages and the scientific era definitely begun in the seventeenth century. Thus his writings seem an odd compound of fact and fancy, of rigorous mathematical speculations and a vague mysticism. Dr. Rufus, of Michigan, who gives a very clear account of Kepler's achievements, protests against attempts to winnow the grain from the chaff—the definite results from what proved mere temporary hypotheses. "That method is as disastrous to the real Kepler as plucking the petals from a wild rose and displaying the bare stamens and pistils"—a statement which shows that even modern astronomers will indulge their flights of fancy. Yet it is difficult to realize Kepler's precise contributions to astronomical science without also indicating that he wasted much time on astrology and on fantastic

geometrical theories of planetary motion which he was gradually forced to drop. A devout Protestant, he suffered much at intervals for the sake of his creed, though, to the credit of the Emperor Rudolf and the Jesuits, he was employed for many years as court mathematician at Prague and for a brief period served as astrologer to Wallenstein. Professor Johnson, of Kenyon College, deals specially with Kepler as a mystic and Mr. F. E. Brasch, of the Library of Congress, has prepared an elaborate account of Kepler's voluminous writings.

The Birds of the Air. By ALLEN W. SEABY. (Black. 5*s*.).

In a book on birds by Professor Seaby we expect the pictures to be the principal attraction, for as a portrait painter of birds he is in the first rank among living artists. And in this work the pictures are, with a very few exceptions, excellent. A good photograph is better than a bad sketch, but a good sketch tells one more than the best photograph. Professor Seaby has the faculty of conveying the essential characteristics of a bird in a few vivid lines. To select the best from his gallery is difficult, but the buzzard, the puffin in flight, and the snipe drumming appeal to our individual taste, and also the coloured picture of lapwings which forms the frontispiece.

The author has an easy, almost conversational style. He has travelled widely, and knows most British species, including the rarer ones. There is some good observation. A young oyster-catcher whom Professor Seaby captured "lay on the path and feigned death. I poked him without his budging. I turned him over and he lay quiescent. . . . I lifted him by one leg and dangled him, at first without any response, until, becoming alive all at once, he struggled violently." Such instances are rare.

The author is incorrect in stating that the nightingale is not found so far west as Devon. Thirty-three nesting pairs were discovered in that county in 1930, and fifty-nine in 1931. The Devon man who stated that he had heard its song there was probably right. There is substantial evidence that the species is gradually spreading westwards. The book is cheap at 5*s*.

Tara: A Pagan Sanctuary of Ireland. By R. A. STEWART MACALISTER. (Scribner. 12*s*. 6*d*.).

Early Ireland is a fascinating but difficult field of study. Professor Macalister has attacked some of its more intricate problems in this study of Tara, the most sacred sanctuary and for a lengthy period the social and political centre of the country. He begins by taking his readers over the actual ground, and with the aid of some illuminating air photographs, essays to identify or locate the monuments enumerated in the Dindshenchas, the "History of Strongholds," compiled about 900 A.D. It is remarkable that this record can still be shown to be substantially accurate, notwithstanding the ravages of farming and the less pardonable activities of those who have sought here for evidence of the "Lost Tribes." The author follows up his examination of the site with a critical inspection of the legendary history of the Irish kings and other traditions associated with Tara, with somewhat startling results. Ingeniously he interprets the evidence to point to the conclusion that Tara was the centre of a cult of twin deities, similar to that of the Dioscuri, and that the king was a priest-king, like the Priest of Nemi, of whom we hear so much in the "Golden Bough," who lost his office and his life when overcome by a stronger rival. The author argues his case ably, and so far as it goes, convincingly, even though there is nothing in the nature of direct evidence. The case rests mainly on the sacrosanct character of the king and his close relation to the fertility and prosperity of the country, for which other explanations might perhaps be put forward.

Newton, the Man. By E. DE VILLAMIL. (Knox. 3*s*. 6*d*.).

This is a valuable addition to our knowledge of the personality of Newton. It is not concerned with the work he did or his discoveries, but it contains new information which illuminates the intimate personal corners in his life that have hitherto largely escaped attention. The author, to whom we are indebted for a piece of painstaking research, gives in full an inventory of the possessions of Newton at the time of his death. Newton, during the greater part of his life was a poor man and doubtless then formed habits of frugality and economy. In his later years at the Mint he was a comparatively rich man, but his simple way of life and abstinence from ostentation and luxury remained as outstanding characteristics. His most luxurious possession appears to have been a Sedan chair! The whereabouts of Newton's library has always been something of a mystery; it was bought after his death by one John Huggins, but many of the books in this list (which at present is at the British Museum) have been missing for close upon two hundred years. The author of this book has discovered a great many of them in the Musgrave library, together with a complete catalogue of it. There are still a great number missing and what has happened to them no one can tell. Nevertheless, the author is to be congratulated upon having unearthed the major part of Newton's library.

Professor Einstein has contributed an interesting foreword expressing his admiration for the work of the author.

An Outline of the Universe. By J. G. CROWTHER. (Kegan Paul. 12*s*. 6*d*.).

The title of this book, offered as an "essay in scientific journalism," represents fairly enough its ambitious character. Dissatisfied with our modern specialization, the author would have the layman try to take a comprehensive view of the universe as interpreted by the several branches of science. He is optimistic enough to think that the spread of the scientific temper would alleviate our political and economic troubles. He gives first the astronomer's tentative conclusions, with a somewhat baffling array of truly astronomical figures. He passes on to the constitution of matter and summarizes the theories of the new physics. Then he treats briefly of the main principles of chemistry, and, with a good chapter on colloids, makes the transition to biology, physiology and experimental psychology. A few pages on the origin of civilization, stating though not expressly accepting, Professor Elliot Smith's Egyptian theory, and a brief and scornful contrast between the foolish politician and the wise man of science bring a stimulating book to its conclusion. Mr. Crowther deserves to be read. He shows considerable knowledge of recent scientific work and he makes some very difficult matters clear to the average mind. But the book as a whole would be improved if it were simplified and the facts and figures too literally provided—especially in the early chapters—were rigorously pruned. The author has not kept steadily in view the needs and meagre qualifications of the unscientific reader or the mere beginner in science, for whom, presumably, the book is intended.

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